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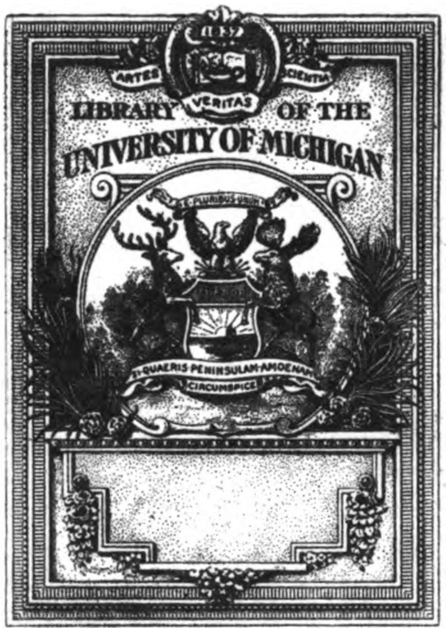

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ELECTRICAL INDUSTRIES.

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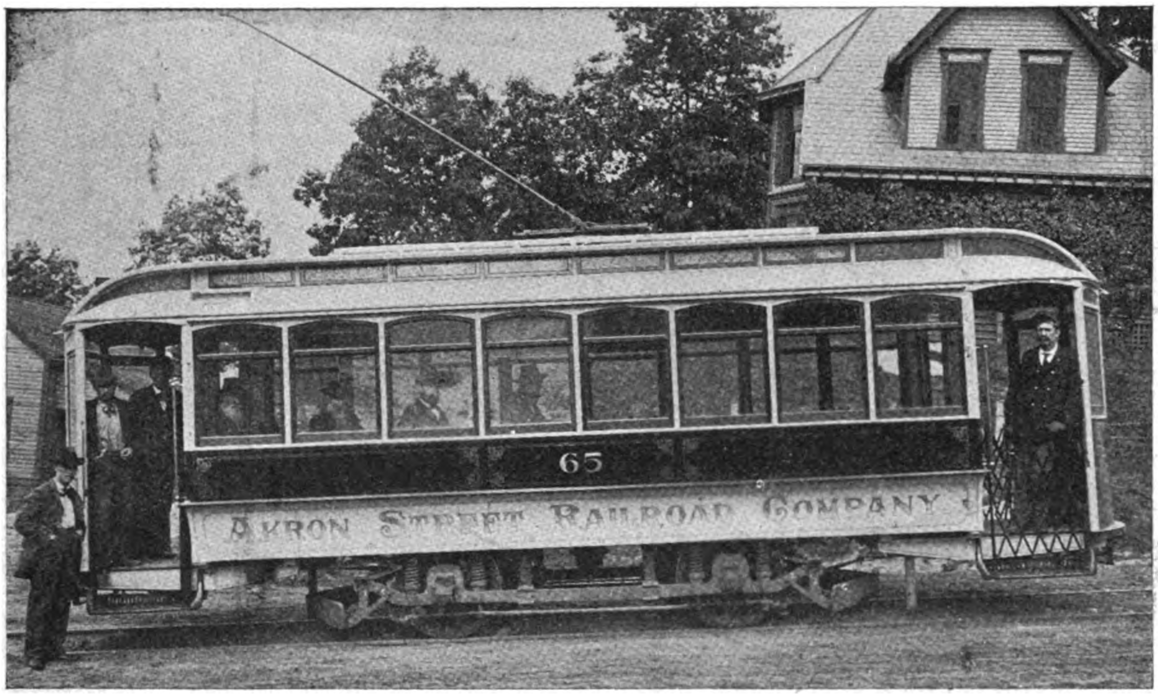
Electric Street Railway of Akron, Ohio.

With a population of about 35,000, Akron may be considered one of the growing cities of Ohio. Situated in a part of the state rich in natural resources and possessing good railway facilities it has reached its present size in a comparatively few years. It is the location of a number of manufacturing industries, and gives evidence in its public enterprises and improvements of the thrift and ability of its citizens. The character of the site upon which the city stands is not the best adapted for the economic operation of a street railway system. The heavy grades with which the city abounds are severe on the rolling stock and the power equipment.

The railway being operated by electricity, these grades are quickly mounted and a satisfactory service is furnished. The superior facilities of the electric railway are quickly recognized, and often lines operated by electricity pay dividends where lines operated by horse-power would scarcely pay operating expenses. The management of this railway system has followed modern pratices in its operation, granting such privileges as the road could afford and furnishing the best running schedule and accommodations the patronage would warrant. The swiftly moving electric cars have greatly encouraged travel and pleasure parties may often be seen on its lines.

The Akron Street Railway Company was incorporated in 1888, and although it has an authorized capitalization of $600,000, but $200,000 of stock has been issued and bonds to the amount of $185,000. The officers of the company are: President, Mr. J. F. Seiberling; vice-president, Mr. Ira M. Miller, and secretary and treasurer, Mr. F. A. Seiberling. The superintendent of the road is Mr. W. D. Chapman. The company has a well-equipped power house with a generating plant of 600 horse-power. The railway system includes 22 miles of single track road. It has 55 cars, of which 29 are motor cars. Upon these cars there were carried during the year 1894, 2,495,850 passengers and 965,450 miles were made by the motor cars.



ELECTRIC STREET RAILWAY OF AKRON, OHIO.

Of the 22 miles of road, fully fifty per cent is on grades varying from 4 to 11½ per cent. Thus on one line, four and one-half miles long there is 11½ per cent grade 1,000 feet long, a nine per cent grade 1,300 feet long, a seven and one-half per cent grade 1,200 feet long and an eight per cent grade on a curve of 190 feet radius. The motor cars on the this line make 216 miles each per day. It will therefore be seen that demands on the power plant and equipment are very heavy.

The motor cars have 16, 18 and 20 feet bodies and were originally equipped with Edison No. 6 motors but the S. R. G. 25 and 30-horse power double motor equipment of the Walker Manufacturing Co. has now been adopted as the standard equipment of the road. These motors were first placed on the road last September, and the excellent service rendered led to their being adopted by the road. The 20 feet cars, with this equipment on the line above described are frequently seen carrying from 80 to 90 passengers.

In Fig. 1 is shown a car on the road. As will be noticed it is vestibuled and equipped with the latest appliances. Fig. 2 illustrates the method of suspending the motors, which is one of the important features of these equipments. One of the greatest causes of wear on the motor and other parts of the equipment of an electric car is the constant jar and hammering which accompanies the passage of a truck over a track. By a method of spring suspension the blow is taken up by the springs and its effects are in this manner destroyed. In the first motor equipments rigidly fixed to the axle and much heavier than any of the present equipments, the effects of the jar and hammer of the heavy and rigid truck was soon noticed in the rail joints and the frequent repairs required by the motor and truck. In these equipments the motor is flexibly connected to the axle and its weight is supported on the springs. Thus it does not have the effect of a dead weight upon the truck. The life of both the motor and the track is by this method greatly prolonged.

The careful and skillful distribution of the metal in the construction of the motor has enabled the manufacturers to produce a motor comparatively light in weight. The yokes and poles have an abundance of metal and strength is given it where required. The motors are of the four-pole type with poles so constructed as to enclose the armature. The field magnet is of cast steel so formed that it encloses the entire motor with the exception of the bearings with their oil and grease cups, which are provided for outside the motor proper. While the motor is thus enclosed the working parts are all accessible, provision being made for inspecting, adjusting or removal of any of the working parts. These parts are thoroughly protected from moisture, snow, dirt or mechanical injury. The interior of the motor, with the armature removed, is shown in Fig. 3.

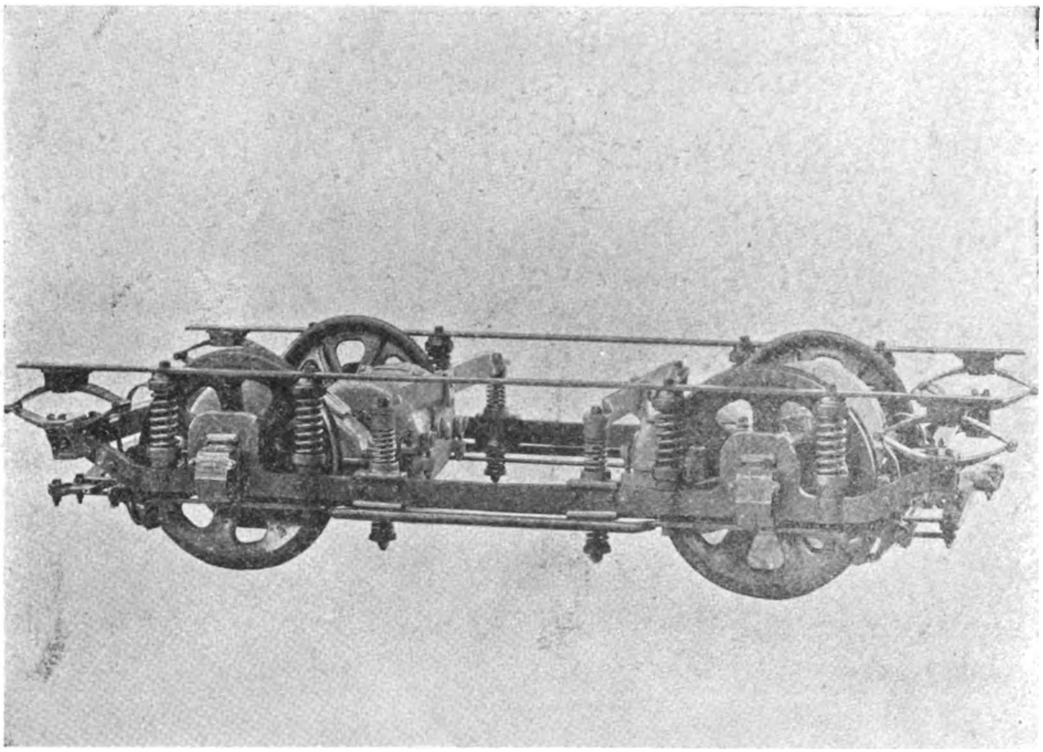


FIG. 2.—ELECTRIC STREET RAILWAY OF AKRON, OHIO.

Another important feature of these equipments is the interchangeability of all wearing parts. The removal of one nut allows the armature shaft to be drawn out. Other parts are as easily removed so that it is a simple and easy matter to replace worn parts with new ones. The armature, which is of the toothed-drum type, is most completely insulated. After it is built and carefully insulated as to its interior, the outside is covered with several coatings of a special varnish which renders it water-proof.

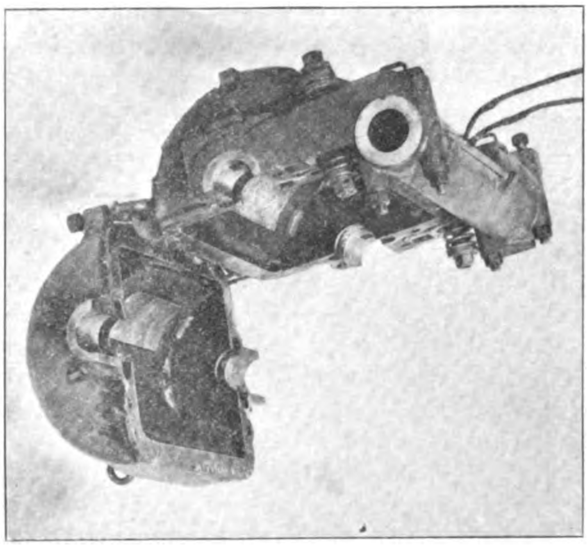


FIG. 3.—ELECTRIC STREET RAILWAY OF AKRON, OHIO.

The commutators and brushes, most important parts of the motor, are strongly constructed. Drop forged copper commutator segments are used and selected mica is employed for insulation. In Fig. 4 is shown the series parallel controller used with the equipments of these cars. The interior construction is illustrated, the arrangement of the connections, etc. Its form is such as requires little space on the platform of the car. It is water proof and contains no combustible material. By loosening two thumb screws the case is opened, giving access to all the parts. The connections are mounted on porcelain and the case is lined with asbestos. The contacts are ingeniously constructed in such a manner as to prevent serious arcing. A quick and long break is made by the contact arms. All the contact fingers are exactly alike and can be easily replaced when worn.

Each controller has two interlocking handles so arranged that it is impossible to move the controlling handle unless the reversing handle is against the stop in either the "ahead" or "reverse" positions. Another important part of the equipment is the starting rheostat. The resistance is made up of sheet iron built in the form of a prism. The whole is enclosed in an iron box, well ventilated but protected.

The cars are also provided with fuse blocks, lightning arresters and switches. These are of an improved pattern and are effectual in their work. An effective lighting arrester for car must afford an easy path for the discharge directly to the ground other than through the motor circuit. It must stop the arc immediately after the discharge and adjust itself automatically for a new discharge. Tests of these equipments have shown their fitness for practical use.

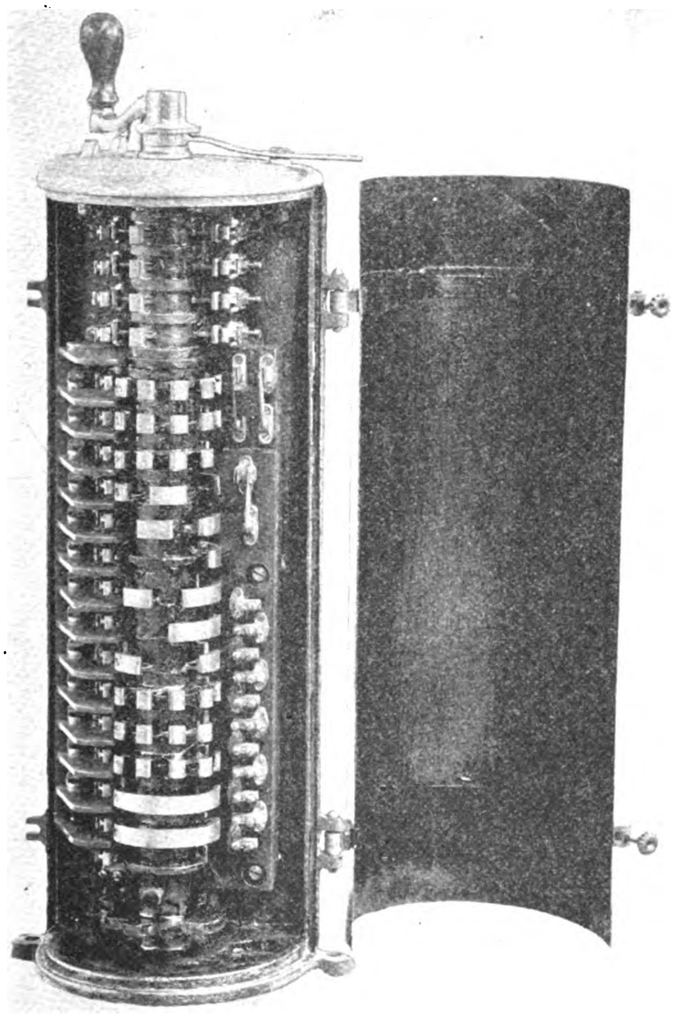


FIG. 4.—ELECTRIC STREET RAILWAY OF AKRON, OHIO.

So satisfactory have these equipments been in the trying and arduous service demanded by these lines during the past five months that, as above mentioned, they have been adopted as the standard equipment of this railway system. At the present time 20 equipments of the Walker Manufacturing Co.'s have been placed in service or are being constructed at the works of the Walker company in Cleveland. Among others roads equipped with these motors might be mentioned the Athol & Orange Electric Railway at Orange, Mass., Passaic & Newark Electric Railway, Newark, N. J., the Hoosick Railway at Bath, Me., and many others in different parts of the country. The new equipments purchased for this railway, which is now in daily operation indicates a growth and promises first class service.

Some Hints on the Building of Electric Plants.—II.

BY CHAS. G. ARMSTRONG.

The next important period in the construction of an electric plant is the specifications.

The specification should be a clear and concise statement of the desires of the purchaser, and in drawing them up the electrical engineer should aim to strike a mean between two extremes—between a specification which specifies nothing and one which says too much. The fault of most young engineers is that they consider the longer and more words they use and the more technical they make their specification the better it will be; while, on the other hand, we often find specifications drawn up by architects and others which call for an electric lighting plant without stating the size, style, or design, or any other essential item of information which would indicate to the bidder what the purchaser really requires.

A specification should state, first—a synopsis of what the plant is to be and what it is to accomplish, i. e., state in a few words what the purchaser believes his plant will be when it is installed. This should be followed by a clear and concise statement of the number of dynamos, their kind, and manner in which they are to be operated; the motive power to be used; a description, either general or specific, of the apparatus to comprise the switchboard. The writer prefers to make this description rather general than specific, naming certain instruments which seem necessary for the peculiar wants of the plant in general, but leaving to the bidder in a measure the minor details of this work. At this point it might be well to remark that the fault of the too rigid requirements of those specifications which specify too much is that it does not give latitude enough to the different bidders. One should bear in mind that in this progressive age each and every manufacturer ef electrical apparatus has more or less of bright electrical talent working out various details to perfect and round out their particular systems, and where specifications are made too rigid many good things which the successful company have to offer would be shovel in the background. The writer is a firm believer in the principle that when a company has been awarded a contract they should be allowed to use their apparatus through the entire contract as far as practical. This gives a symmetry to the entire plant and gives the contracting company a closer interest in the success of and the subsequent operation of their apparatus.

The number and size of dynamos to be used can be determined by the electrical engineer from the curves made by him, as described in the previous article, and the division of the dynamos should be such as will economically handle the load as shown in those curves throughout the entire run as the plant, whether the run be for a few hours or for twenty-four hours per day.

The dynamos should be subject to an insulation test and should be required to stand a continuous operation of twenty-four hours under a certain reasonable heating limit. The writer has assumed that 80 degrees Fhr. is about the maximum limit, having found that a dynamo which does not heat more than 80 degrees Fhr. above the temperature of the surrounding atmosphere is in a safe working condition. The heating limit must necessarily be an arbitrary one, and good judgment combined with experience is the safest guide in determining it.

As to the kind of switchboard to be used, whether it be of the bus bar pattern, with connections on the face of the or whether the connections are to be made on the rear, depend considerably on the work to be accomplished. The designer should not lose sight of the fact that the less apparatus he has on the board and the simpler it is made the better his plant will work and the less repairs it will require.

The ordinary engineer or electrician in charge of a plant has not the time or knowledge necessary to make himself familiar with the complicated switchboards which we meet in the different plants. There is much to be said on the pattern and general style of switches—those with connections on the face and those with connections on the rear of the board. Generally, those switchboards which have their connections on the face are more satisfactory than those having their connections on the rear. The simplicity of the face of the rear connected board is more than compensated for by the complexity of the rear wiring.

Great care should be taken in specifying the apparatus on the board to have them of sufficient carrying capacity. In a great many plants an abnormal drop in voltage has been traced to the switchboard itself where three, four and five volts loss can be found, and in one instance the writer found that 1½ horse power was lost in passing through one large switch.

The designer should pay particular attention to the connections and joints upon his board and readings should be required to be taken with a delicate voltmeter for loss of potential through the board when carrying maximum load, and the contractor should be held strictly accountable for any abnormal loss. This same criticism can be applied to centers of distribution and cut-out cabinets. A faulty joint often causes dim light, and sometimes to the sorrow of all concerned it causes a serious fire; hence it is doubly important that careful and conscientious tests be required after the plant has been installed, to detect defects of this kind. The designer must not forget that the contractor is only a mortal and may by design, oversight or neglect, have some or all of these adverse conditions arise in his plant.

The designer should describe the number of risers or feed wires which he desires to use and give some idea of their connections to or from the switchboard. And in addition to this should use the greatest caution in specifying the quality of wire to be used. Sometimes the purchaser has a preference for wire or other material which he wishes used in the plant, which preference is of course perfectly legitimate, as a man has the right to purchase what he pleases with his own money, yet it is often the unpleasant duty of the electrical engineer or designer of the plant to persuade the purchaser to use something else, from the fact that his, the purchaser's selection, is made from prejudice or personal friendship, and not with regard to the needs of his plant. The safest course in regard to wire is to specify what will be expected of it, and what mechanical or electrical tests it will be subject to and as a further precaution the engineer should keep a constant check on the contractor by taking samples of the wire furnished and inspect them, in order that by accident or design an inferior quality of wire may not be substituted. As to the carrying capacity of wires there are an abundance of tables giving maximum carrying capacities. In addition to this the writer is a firm believer that no conductor of any description in a plant should heat more than 40 degress Fahr. above the temperature of the surrounding air and always includes that clause in his specifications.

The lamp schedule should be a concise statement of the number of watts required stated in lamp units, i.e., a schedule can be made for lamps or horse-powers desired and explained by a statement as to how many watts constitute a horse-power or lamp which explanation should always accompany the specification.

Switches should be used in all cases where possible as the key socket is a makeshift at best and the constant handling of the same soon works the fixture loose. In considering the carrying capacity, the remarks on switchboard apparatus apply equally as well, i. e., great care should be taken to have no abnormal loss through the switches.

The system of distribution must depend entirely upon the conditions to be met. The feeder-main system which has been claimed by the Edison company but which has recently been decided by the courts as public property, is the most rational way of equalizing pressure in our large buildings, and is almost indispensable in railroad service, while in alternating current municipal work and other of like character it is not so important and a tree system can be used with good satisfaction.

In house distribution the cabinet system should be used for the distributing wires. The cabinets should be made absolutely fire proof, located as centrally as possible; the distributing lines should radiate from these points to the lamp outlets. One source of great annoyance can at this point be easily circumvented i. e., inferior wiring in the electric light fixtures or electroliers. While insurance companies and electric light inspectors have been paying fairly close attention to systems of wiring they have almost entirely neglected ordinary precaution in dealing with the question of wiring fixtures. One weak point in fixtures is the canopy. The object of the canopy is to hide the point where the fixture is connected to the gas pipe and also to conceal the electric wires which must be somewhat loose at this point. Where the fixture screws to the gas pipe or blind outlet, by a wise and commendable forethought on his part, the fixture man provides an insulating joint which insulates the fixture from the gas pipe, electrically, yet prevents the gas from escaping and conducts it down into the fixture. After spending a dollar or two on this great improvement he takes a canopy which is of metal and connects it to the lower or insulating portion of the fixture, pushing it up until it touches the wall above in many cases at the same time, touching the top of the insulating joint, making a bridge of more or less resistance which grounds the fixture almost as readily as if the insulating joint were not there. The designer has a chance here to make a step in the right direction by specifying a better method of connecting and also the use of the insulating canopy. In many cases where great care has been taken to specify the exact size of wire throughout the building the wire in the fixture is not mentioned. This point should be looked into and covered in the specifications.

At this point the designer should remember that no electric plant where the wiring is to be concealed, should be installed without such wires being covered by some system of interior conduits. I do not consider a plant safe unless every wire can be readily removed at any time for inspection or renewal, and that can only be accomplished by the use of raceways and conduit tubes.

Too often have I seen fine decorations ruined in order to remove grounds, that could have been removed at practically no expense if conduits had been used.

Nor should one use a wire of inferior quality by the reason of the tubes, but regard them only as a mechanical device—a hole in the plastering simply—by means of which the wires are made accessible.

The specifications should also contain a clause protecting the purchaser against litigation and law suits in connection with the use of any patented device which he may purchase, and above all a clause should be inserted making it obligatory on the part of the contractor to have his plant so constructed that it will stand certain reasonable tests before it shall be accepted and paid for. This test should consist, first, of an expert examination to see if the apparatus complies with the plain requirements of the specification, and second, whether the plant as installed will operate continuously and successfully. It is usually best to make a test of about thirty days as any latent mechanical or electrical defect will come to the surface after a run of that duration.

Throughout the entire specification the designer should bear in mind that there are just as good fish in the sea as have ever been caught, that there are a great many new companies who know how to make good apparatus as well as the older and larger companies, and that all companies who have merit should be accorded the privilege of bidding on the same footing and upon equal terms with any other company. The designer should lay aside all prejudice or personal feeling and specify openly and clearly, giving a fair show to all bidders to compete on the work. This insures to the owner a better price and if the specifications are properly made, a better plant when completed.

Specifications made in this manner call out a uniform class of bids, i. e., each man knowing distinctly what is to be furnished, what is desired to be accomplished and how it is to be accomplished, makes an intelligent bid, and contracts based on a specification as described herein, bar out the extra bills upon which some companies hope to make their largest profits. One of the great advantages to be obtained from a clear and concise statement of what will be required, in your specification, is that you will receive closer bids. For every item of uncertainty the bidder will add a few dollars to make himself safe. It therefore behooves the designer to have as few of these uncertainties as possible, as he will thereby save money to his client, the purchaser. I wish to impress thoroughly on the minds of thos who read this article the necessity for absolute independence of all selfish interests in designing a plant for his client. Honesty of thought, of action and of purpose are the requisites for a good specification and he who will succeed must study carefully a broad-minded principle of fair and courteous treatment to all, with the desire to obtain that which is best at the least possible cost to his client; leave out all fol de rols and avoid fadism or arrogance, looking only to the good of his client and the advancement of the noble science which he represents in order that during the third stage, or that of installation and construction he will find that he has men to deal with who are his servants and and not his masters and the things for which he has contracted are those which fill the requirements of the purchaser.

Among the new electric railways projected is one to enter Yosemite Valley, California. Tourists now leave the railroad at either Merced or Raymond and make the trip through the valley by stage. The way is mountainous and four days are required for a round trip. An electric road would enable the visitors to see much of the country in a few hours and more tourists would visit it. The road would be very expensive to build, but the income would undoubtedly yield a sufficient return on the investment.

The Alternating Current; Its Generation and Distribution.—IV.

BY PROF. GEORGE D. SHEPARDSON.

Alternating currents may be obtained from continuous currents by means of a commutator or pole changer. The direction of the current may be changed at will by means of a reversing key, a common laboratory form of which is shown in Fig. 9. This consists of a rocker having at each end three wire feet which are connected together but are insulated from the three feet at the opposite end. The base has six holes filled with mercury, four of the diagonally opposite holes being connected in pairs by means of insulated wires. If a source of continuous current is connected to the terminals at the side or to those at the ends, current will flow first in one direction and then in the other through the circuit connected with the other terminals, as the rocker is tipped to one side and then to the other.

A similar form, show in Fig. 10, consists of a block of wood containing four holes filled with mercury and a second block containing two U-shaped conductors of heavy copper wire. The wires from the battery or other source of continuous current are connected with diagonally opposite cups, and the terminals of the circuit through which the alternate current is to be sent are connected with the remaining two cups. Connection is established between the battery and the other circuit by placing the cover upon the base in such a way that the U-shaped conductors dip into the mercury cups. The connections are reversed by lifting the cover, turning it 90° and again dropping it with the conductors dipping into the mercury.

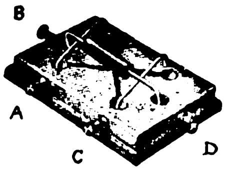


FIG. 9.

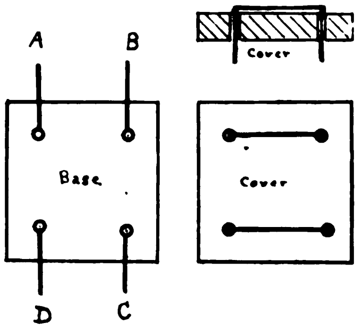


FIG. 10.

THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

A larger and heavier form of switch used for reversing the current supplied to railway motors and for similar purposes, is shown in Fig. 11. The two outside contact blocks on the upper side are connected together by a stout wire on the back. Two movable conductors are pivoted at the lower side and are connected by an insulating strip by which both may be moved at the same time toward the right or left for reversing the current.

The reversing switches shown in Figs. 9, 10 and 11 are only a few of a large variety to be found in laboratory and commercial work. These are suitable for reversing currents at comparatively long and irregular intervals. When it is desired to obtain from a continuous current one that alternates with considerable rapidity and regularity, a rotating device is preferable. A convenient form, known as Pixii's commutator, consists of a cylinder of insulating material mounted on a suitable axis and carrying a metallic sleeve which has been divided stepwise. The parts of the sleeve are insulated from each other and are so placed that the long portion of one is diametrically opposite the other as shown in Fig. 12. Two stationary springs or brushes, *B* and *D*, rub against the continuous portions of each part. A third brush *A* is placed near the middle so that it makes contact with one segment during half a revolution of the cylinder and with the other segment during the second half of each revolution. A fourth brush *C* is placed so as to touch the segment at a point diametrically opposite *A*. As the cylinder revolves it is seen that brush *A* is electrically connected with *D* and brush *C* is connected with *B* during half of each revolution, but during the other half revolution *A* is connected with *B* and *C* is connected with *D*. It then follows that if *A* and *C* or *B* and *D* are connected with the terminals of a battery or other source of continuous current, the current in the circuit connected with the other pair of brushes will flow alternately in one direction and then in the other. The "frequency," or the number of alternations per second will depend upon the velocity of the cylinder.

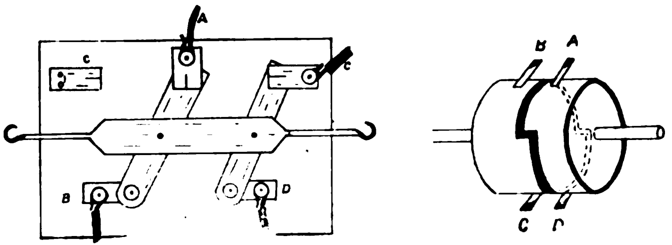


FIG. 11. FIG. 12.
THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

The same commutator may be used to "rectify" an alternating current. If the cylinder revolves at the same rate that the current alternates, the current taken off will be uni-directional if the middle pair of brushes *A* and *C* are set so as to change from one segment to the other at the right instant. All continuous current dynamos use commutators which are developments of this one invented by Pixii in 1832. A similar device is used on many alternate current dynamos, often called alternators, which rectify part of the current for the purpose of self-regulation, as will be explained later.

Another method of obtaining alternating currents from continuous is by the use of the induction coil, such as used by physicians, and in connection with telephone transmitters and other apparatus. The induction coil will be considered later in connection with alternating current transformers.

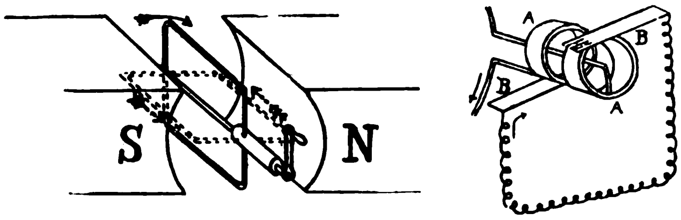


FIG. 13. FIG. 14.
THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

The above methods of obtaining alternating from continuous currents are economical only in cases where small currents are needed. The dynamo-electric machine driven by steam or other power is ten or twenty times more economical than chemical batteries as a source of electrical energy and is almost universally used when large amounts of energy are involved. All direct methods of obtaining alternating currents from other forms of energy are developments of the principle of induction discussed in the last paper. (ELECTRICAL INDUSTRIES, Vol. V, page 366, December 1894.)

Methods of obtaining alternating currents by induction may be classified upon the basis of the source of power. Changes in the number of lines of force enclosed by an electric circuit may be caused by mechanical or electrical power or by the action of heat. The last method may be passed over quickly as it has not been developed to a commercial extent.

Gore, Berliner, Edison, Menges, Tesla, Acheson and probably others have attempted to make use of the fact that the permeability of iron for magnetism varies with the temperature and that it looses its magnetic properties entirely when white hot. By arranging part of the magnetic circuit so that it can be alternately heated and cooled, the number of lines of force enclosed by a coil of wire surrounding the iron will be alternately decreased and increased and corresponding E.M.F's will be induced. Such devices, known as pyromagnetic generators, have not yet passed the experimental stage.

Devices in which the change in the number of lines of force is brought about electrically, should be considered as "transformers" rather than as "generators," because the amount of electrical energy given out is never more than that received. These will therefore be considered later in connection with the methods of distributing energy by means of alternating currents.

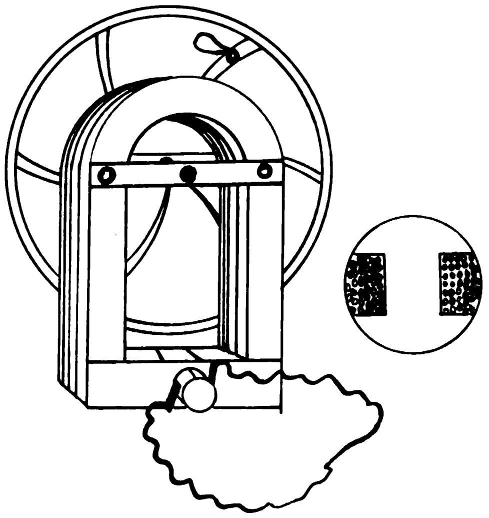


FIG. 15.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

Under the head of electrical generators operated by mechanical power, mention might be made of the telephone and the galvanometer damping coil described in the last paper. The dynamo electric machine as found in commercial use, is a development of these simple devices. The elementary machine may be considered as a loop of wire rotating in a magnetic field, as suggested in Fig. 13. As the loop rotates, the two sides parallel to the axis cut the the magnetic lines of force passing from the north to the south pole of the magnet. By referring to the rule of thumb suggestion in Fig. 6 (ELECTRICAL INDUSTRIES, December, 1894), it is seen that if the loop rotates in a clockwise direction, as indicated by the curved arrow at the top, the E.M.F. induced in the left side of the loop tends to send current toward the handle, while that induced in the right side of the loop tends to send current toward the handle. Both of the E.M.F.'s tend to send current in the same direction in the wire. This would still be true if instead of one loop of wire, there were a large number of loops side by side and connected in series so that the same current would flow through all. By having a large number of turns of wire, the E.M.F. would be increased proportionally.

Further study of Fig. 13 shows that when the loop has reached the position shown in full lines, the loop encloses the maximum number of magnetic lines of force. As the loop continues to rotate, the number of lines enclosed becomes less until no magnetic lines are enclosed at the position shown in dotted lines. As the loop moves further, the magnetic lines begin to be enclosed again, but in the opposite direction. Similarly by considering the E.M.F. as being induced by the rate of cutting lines of force, it is seen that when the loop has completed half of a revolution, the side which was at the right will be on the left side. It follows that the E.M.F. in the wire is also in the opposite direction. The E.M.F. reverses when the loop reaches the position perpendicular to the lines of force, that is, when the number of lines enclosed is the greatest, and when the sides of the loop begin to cross the magnetic lines in the opposite direction. Such a loop therefore induces an alternating E.M.F. and produces an alternating current.

In order to send the induced current through an external circuit, it is necessary that the two ends of the revolving loop be well insulated from each other and that each end have some means of continuous connection with the outside circuit. This may be accomplished by having the ends of the coil connected with insulated rings, against which stationary brushes may make contact as suggested in Fig. 14. In some actual machines of small size, one end of the shaft upon which the coil rotates, is insulated from the rest of the machine and one end of the coil is connected with the insulated end, while the other end is connected with the other part of shaft and so with machine.

The well-known "magneto," used so largely for telephone calling and for testing purposes, consists essentially of a loop of wire wound in a great many turns about an iron core and rotating between the poles of a strong permanent magnet of hardened steel, one form being illustrated in Fig. 15. By means of a train of gears or pulleys the coil is rotated with considerable velocity and an alternating current of several hundred volts is sent out through the line. More electric generators of the magneto type are in use than of all other types put together, although their combined power is comparatively small.

Papers for the National Electrical Light Association Convention at Cleveland.

A partial list of papers to be read at the next annual convention of the National Electric Light Association to be held at Cleveland, O., on February 19, 20 and 21 has just been announced by the secretary. Other papers will be announced later and topics for discussion upon which data are now being collected by the committees. The list of papers so far given out is as follows:

"Some Economies in Electric Light and Power Stations," by Professor Edward Weston.

"Arc Carbons and The National Electric Light Association Standard of Light," by L. B. Marks.

"The Monocyclic System," by Dr. Louis Bell.

"The Correct Method of Protecting Electric Circuits," by W. E. Harrington.

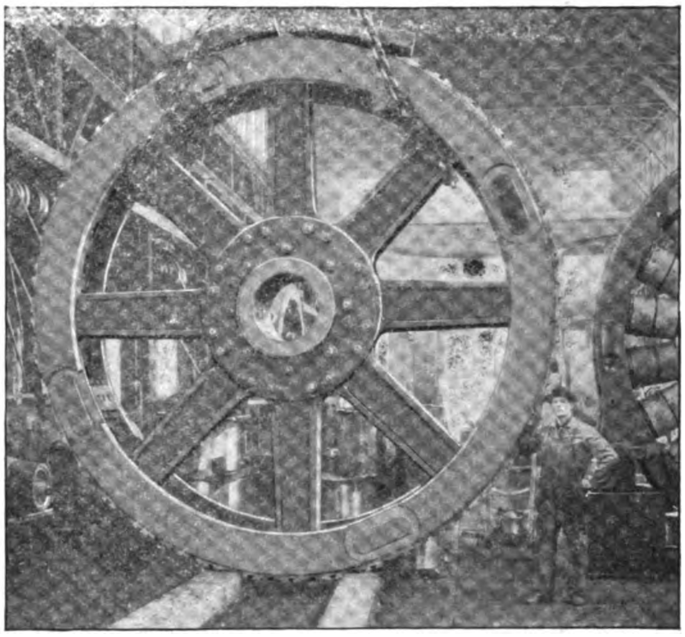
"The Evolution of Arc Lighting Machines," by C. N. Black. E. A. Leslie's paper, read at the Buffalo meeting, and entitled "The Operation of High Tension Currents Underground from a Physical and Financial Standpoint," will be taken up and discussed.

The Central Traffic Association has granted the application for excursion rates to the convention. The rate from all points in its territory to and from Cleveland will be one and one third the regular fare. The other associations will undoubtedly concede the same rate.

Some Heavy Castings for Electric Generators.

The Edison Electric Illuminating Company, of St. Louis, Mo., is soon to have one of the largest alternating current generators ever constructed. The generator will supply current for both incandescent and arc lighting and also for motor service. The castings are of course in proportion to the size of the machine and required unusual facilities in the foundry for casting and handling. These were provided at the works of the General Electric Company.

In order to secure efficient results for the various uses, the generator is constructed on the monocyclic system, recently adopted by the General Electric Company. This system employs a comparatively low frequency of alternations and the armatures of the generators have special windings adapting them for use on circuits with self-starting current motors.



SOME HEAVY CASTINGS FOR ELECTRIC GENERATORS.

The generator illustrated is of 800 kilowatt capacity; has 80 poles and is to be driven by a Hamilton-Corliss engine at 90 revolutions per minute.

On account of the great size of the frame difficulties were to be expected in producing the castings, but with the facilities of the Schenectady works no trouble was experienced in pouring even the large frame casting. This single piece made up in part of wrought iron embedded in the casting weighs 35 tons and measures 23 feet over all. The armature is ironclad and is 16 feet in diameter, weighing nearly 100,000 pounds. The armature will be supported on a 22-inch shaft.

The illustration shows the armature spider before the laminations were placed upon it. An idea of its size may be had by comparing the spider with the 400-kilowatt rotary converter, which stands to the right of it.

The completed generator will supply, when at full load, 667 amperes at 1,200 volts, equivalent to 16,000 candle-power lamps.

In this connection it should be stated that the great size of the generator was necessitated by the requirements under which the machine is to be operated, chief of which is the low speed of revolution.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

A happy and prosperous new year for each or its many readers is the wish of Electrical Industries. May the year 1895 be a successful one to our subscribers and advertisers, yielding good and sufficient returns for the efforts expended.

It has been well said that experience is man's sternest teacher. Nowhere is this more fully shown than in the business world. The past year has been full of experiences and in the coming years better results will be attained through them. The year 1895 opens with brighter prospects and promises a greater and stronger business activity. In another column will be found the views of a large number of the prominent men in the electrical industries, which show the encouraged feeling that pervades the trade.

Frequent inquiries are received from persons who desire small isolated lighting plants for lighting stores, factories, shops and residences. The inquiries come from the smaller towns having no central station, and information is usually desired concerning the cost, expense of operation and the address of the manufacturers. The applicants usually are without power and desire a complete plant, a plant which will be almost self-operating, safe and reliable. There is without doubt a large demand for equipments of this kind. To meet this demand a complete plant must be offered. It is not sufficient to offer a dynamo and refer the purchaser to another company for the power equipment. The trade know little about such plants and want to deal with one company for a complete equipment guaranteed to do the work.

The year 1894, which has just closed, has been a period of recovery rather than of marked advancement. It opened with not very bright prospects for the year's business. Factories and work shops were working small forces and short hours, or were entirely closed. Large armies of unemployed were in every business center and business was at almost a standstill. Economy was everywhere the rule, and the demand for goods of any kind was extremely light. During the year the condition gradually improved, the demand for goods increased, the force of workmen in the shops and factories resumed its normal strength, and the regular number of hours worked. The November election and its favorable result gave confidence to business enterprises, and men and capital have taken up many of the projects laid down the previous year. The number of failures of electrical companies was large, many having exhausted their resources in passing through the business depression and were unable to recover with the too slowly returning business activity. Some of the larger companies have, however, increased their manufacturing facilities and extended their field of operations. There has been considerable activity in electric railway circles and in the larger cities the adoption of this form of power has been especially marked. The central stations have increased in number, and some of the finest plants have been installed during 1894. The number of applications of electricity has multiplied and its advantages for the distribution of power have been more fully recognized. While no great discoveries or remarkable inventions in the industry have been made known during the year the value of those already in use have been more clearly recognized.

In the December number of Electrical Industries, Mr. H. G. Brownell in an article on electro-plating plants, called attention to the loose methods in vogue in plants of this kind, the careless methods of installation and the expensive manner from an electrical point of view, in which they are operated. While this is one of the older applications of electricity, it has not been characterized by the display of engineering skill that is noticeable in other and more recent applications. Some, in fact comparatively few, plants have been installed with the careful attention to details which is found in nearly all lighting and power plants. Manufacturers when embarking in enterprises, often hesitate to expend the amount necessary to place in permanent form the factory and its equipment. The possibility of future enlargement or some change in present arrangement is often an excuse for a construction which is most defective. The result is an equipment expensive in operation, inefficient and unable to produce such results as the present state of the art would warrant.

The examination of conductors and motormen on electric railways to ascertain the condition of their senses of seeing and hearing is being required on a large number of the roads. President Beckley, of the Rochester Railway Company, recently issued an order requiring the motormen and conductors of the road to present themselves to Dr. Rider, a prominent specialist of that city, for the examination of their senses of seeing and hearing, and hereafter applicants for positions on that railway will be required to give satisfactory evidence in an examination, of perfect eyesight and sense of hearing. As electric traction has made it possible for passengers to be transferred from one part of the city to another or from one suburb to another suburb in a short space of time, it has increased the dangers arising from the passage through thickly populated streets of swiftly moving cars. The safety of the riding as well as the walking public rests in a large measure upon the motormen and conductors. Through crowded streets or districts where railway crossings are numerous the responsibility of the motorman is great. In thinly settled districts and in the suburbs accidents are as frequent proportionately as in the crowded parts of the city. The motorman must always be on the alert, and while his hearing and seeing must be good, his physical and mental faculties should be unimpaired. Although not required by law, the examination of applicants for the positions of motormen and conductors should be rigid, and a certificate from a competent physician in which the accuracy of the senses of hearing and seeing is set forth, should be one condition of his receiving a position in the employ of any electric railway company.

The decision rendered last month by Judge Carpenter in the case of the Government vs. The American Bell Telephone Company unless reversed by a higher court ends the control by the Bell company of the fundamental telephone patents. The progress of the suit had been closely watched and the decision has awakened considerable public interest. The many companies that have been manufacturing telephones since the expiration of the Bell patent in January last are especially well pleased with the result. This decision declares void the Berliner patent, application for which was made in 1877 and a patent issued in 1891. It covered all forms of the microphone and had it been sustained would have prolonged for 14 years the Bell company's monopoly of the telephone field. The decision is based upon two grounds. The first is that certain claims of the patent were covered in the Berliner patent of 1880, one of the functions of the devise as described in the former patent being identical with the function of the devise covered by the patent of 1891. The patent, therefore, seems to the judge to be void and beyond the power of the Commissioner to issue. The second ground is that the issue of the patent was unlawfully delayed. Upon these grounds the patent is declared void and ordered to be delivered up for cancellation. While the expiration of the Bell patents opened up to public use the magneto-telephone its use was limited to shorter distances, and the currents were easily affected when near lines carrying lighting or power currents. This decision makes public property the battery telephone, and although the different parts of the instrument as used by the Bell company are covered by minor patents manufacturers will undoubtedly find a way to produce satisfactory non-infringing instruments. The only hope of the company gaining again even a partial control of the fundamental patents is a reversal of this decision by the Appellate Court or a favorable decision in the Bates Refrigerator case which will give life to some of the Edison patents. The probability of this, however, seems slight. The American Bell Telephone Company has been one of the most successful of business enterprises. Probably no company can show greater success from the start. The almost priceless invention which it has owned and controlled would have yielded less returns but for the superior and far-seeing ability of its managers. During the period of its monopoly the company has possessed itself of the field and tied the large cities and intermediate towns together. With large resources and abundant capital it has developed a system as important to commerce as the telegraph and as thoroughly established as the Western Union system. The patents of the company cover the mechanical details of its instruments and exchange apparatus and have a longer or shorter period to run. New companies have already put in many exchanges in the smaller towns and cities, and in this direction, especially in the newer States, they have abundant opportunity for the introduction of telephone systems. Instruments and exchange switchboards which are reported satisfactory in operation and non-infringing in construction are already on the market and in use.

The Suburban Traction Company of Orange, N. J., has been placed in charge of Mr. Watson Whittlesey, receiver. The company operated an electric line in the southern part of the city to East Orange, and a horse line in East Orange and Bloomfield. The application for a receiver was made by the American Loan & Trust Company of Boston. The chief cause of the failure was the damage suits brought by the victims of an accident on the Eagle Rock section.

Arc Lamps in Mills and Factories.

With the improvement in methods and processes of manufacture and the more general use of labor saving machinery, ideas respecting workrooms have greatly changed. Well ventilated and lighted rooms are now looked upon not as matter of extravagance but as necessities conducive to the success of the enterprise. The electric light since its introduction has been a great improvement over other forms of lighting for buildings of this kind, consuming none of the oxygen of the air and throwing off no unhealthy gases, while the light given excells in cleanness and volume. Its advantages have been generally recognized and its adoption rapid.

The two forms of electric lighting, incandescent and arc, have each important claims for certain classes of factories and their selection in an individual case depends on the character of the service rendered. For large rooms the arc lamp has special claims, among which is the greater economy for amount of light given. Its near approach to natural light and the ease with which it is used in large areas, has made it a popular light for factories, mills, etc. Its use is varied in different kinds of factories and the method of hanging and the reflectors used are modified so as to give the best results. In cotton and woolen mills which are filled with highly inflammable material, the danger arising from the use of any open light is great. Gas, while but a poor substitute for natural light is probably as dangerous as any form of light.

The arc light when first tried was considered unsatisfactory on account of the very black shadows and the liability of fire from the pieces of carbon which were then thrown off. Improvements in the manufacture of the carbons and guards overcame the latter defect and the arc lamp with enclosing globe and wire net has been generally used. In the attempt to overcome the difficulty of black shadows and secure a better diffusion of the light, the lamps have been inverted and the light thrown upon the ceiling from which it is reflected. The first adoption of this method is credited to the French from whom it was copied in England.

The first use undoubtedly of the method in the United States was made by Mr. Darius L. Goff, of the Goff Braid Mills of Pawtucket. Mr. Goff had noticed the practice in several of the cotton mills in England and the satisfaction it gave. He brought with him on his return a number of arc lamps such as were there used. These lamps were placed in his mills but were found too expensive for general use, so the ordinary arc lamp was modified to fill the requirements. The light is thrown on the ceiling, from which it is reflected in all directions.

The first impression upon entering a room lighted in this manner is that the room is dark, but on taking up a paper to read the print appears distinct even when not held so as to get the direct reflection, the white walls reflecting the light. The dazzling glare of the ordinary arc lamp which affects the sight so that as you turn from it objects are not easily distinguished, is entirely absent. The lights are not numerous, there being one to about every 1,500 square feet of floor space. The rooms are free of columns and have little overhead shafting or belting, but the light on the floor and under the braiding machines is said to be good and the operatives are fully satisfied with the light.

The danger of fire is greatly reduced by this method. While it is slight in foundries and other places where the material worked is incombustible in cotton mills where there are large quantities of highly inflammable material the danger is constantly present. The globes are not a sure protection since the carelessness of trimmers in failing to replace damaged globes has in several instances resulted in fires. The globes also obstruct the light and greatly reduce its brilliancy. By the inverted arc system the metallic reflector beneath the arc and partly enclosing it, makes the most satisfactory protector, as it catches all particles of carbon that are thrown off. It is also indestructible.

Fred E. Degenhardt.

It was with the deepest sorrow that the many friends of Mr. Fred E. Degenhardt learned of his death which occurred on December 7th. Having been absent from business but five days, few had learned even of his illness, and therefore were unprepared for the sad intelligence. A pleasant and cheerful acquaintance, a firm friend and successful business man he is missed throughout the wide circle in which he was known. A lifelong resident of Chicago, he was thoroughly conversant with its history and the trade throughout the large territory in which he so ably, during nearly the last decade, represented the interests of the Standard Underground Cable Company, of Pittsburg.

Mr. Degenhardt was born in Chicago in 1856, and received his education at its institutions. After completing his course of study he remained for a time in the instrument factory of his father, Mr. Charles Degenhardt, who was the first manufacturer of surgical instruments in the West. He was for more than six years identified with the Northwestern Electric Light Company, first as superintendent and afterwards as manager. For a short time he held a position of contracting agent for the Western Electric Company, and then took the position of western manager for the Standard Underground Cable Company, a position he filled very successfully for the last nine years.

FRED E. DEGENHARDT.

Familiar with the different branches of the electrical business, and especially with cable and underground construction work, he was particularly successful as a salesman. His inventive talent, which was probably cultivated while with his father, demonstrated itself in many electrical appliances. While some of these were in connection with the line of business with which he was engaged, others were special lines which he took up at odd moments. Many will remember the electrically propelled chair which was designed to compete with other vehicles for use at the World's Fair. This was designed by Messrs. Degenhardt and Keller, and it was a considerable disappointment to them that it did not receive the serious consideration of the management. On current events in the business and electrical advancement he was well posted and took an active part in electrical organizations in the city. His naturally social disposition found congenial society in several clubs of which he was a member and at his pleasant home. In 1885 he married Miss Emily Lockwood of Tarrytown, N. Y., who with two children survive him. His home life had been especially happy.

At a meeting of a number of the friends of Mr. Degenhardt it was decided to prepare a suitable memorial. This is now being executed and when completed will contain a likeness, the resolutions passed at the above meeting together with other appropriate matter.

Necrology.—1894.

Paul Jablochkoff, born 1847, died 1894, a distinguished Russian inventor whose name has been particularly connected with the electric candle, which he invented—the Jablochkoff Candle, that lighted the Avenue de l'Opera, Paris, in 1878. This electric light gave way to the modern arc light which came out soon after. He first entered the military telegraph service of his country after completing his education, but after a few years gave it up to devote his entire time to inventions.

Jacob Livingston Barclay, born 1867, died 1894, was a most successful representative of several electrical manufacturing interests. At the time of his death, Mr. Barclay was the western representative of the Walker Manufacturing Company, of Cleveland, Ohio. He commenced his business life as a wire salesman for Holmes, Booth & Hayden, and was afterwards connected with the Sprague, Westinghouse, and other companies. He was a young man, full of life and enterprise, and had just started upon what promised to be a most successful career.

Heinrich Hertz, born 1858, died 1894, an eminent physicist. Although but 36 years of age at the time of his death, he had made a lasting reputation through his discoveries and experiments, many of which bear his name. The results he had obtained were so clearly set forth and his arguments so logical that they received immediate acceptance from the men of the time. He was born at Hamburg, studied at the University of Berlin, and afterwards made a special study of physics under Helmholtz and Kirchhoff. His ability was early recognized and he accepted a professorship at the University of Bonn, where he occupied the chair of physics, after having served several institutions as a lecturer and instructor. His death occurred at Bonn, on January 6. His life was unusually brilliant, and the sudden termination of his career was greatly regretted in scientific and educational circles.

J. Hood Wright, a well-known banker and a member of the firm of Drexel, Morgan & Co. He early became interested in the development of electric light and power enterprises, and since 1882 was a director of the Edison Electric Illuminating Company, of New York.

William J. Stephenson, president of the Metropolitan

Railway Company, of Washington, and vice-president of the American Street Railway Association. He had been interested for a number of years in street railways and was well known in street railway circles.

William F. Cullen, connected with the E. P. Gleason Manufacturing Company, and with which he had held a prominent position for several years. Commencing as a boy his ability and integrity soon won the confidence of his employers. He was well known and well liked by the trade in the east.

Charles H. Rudd, an electrical expert, connected with the Western Electric Company, met his death in an unexpected manner while testing a new explosive. He was the inventor of a number of useful electrical devices, and was a man of acknowledged ability. He had held a position with the above company for a number of years, and was highly esteemed by those with whom he came in contact.

William Richardson, born 1822, died 1894, well known in street railway circles, and for a number of years president of the Atlantic Avenue Railroad, Brooklyn. Took a great interest in the meetings of American Street Railway Association. During his connection with the Atlantic Avenue railway its motive power was changed to electric and it now represents one of the most modern railways in its equipment. His connection with railway interests dated from the close of the late war.

Edmond Julien, born 1838, died July 5, 1894, a distinguished engineer. He built what was the first storage battery factory in Europe. In 1885 his storage battery car took the prize at the Antwerp Exposition. In his earlier work in the practice of his profession, that of a civil engineer he obtained the highest rank. For his work for science and industry he was knighted in 1889 by King Leopold.

John Worthy, president of the Metropolitan Elevated Railway Company, Chicago, died in New York City on December 12. He was born in England in 1841, and came to America when but eleven years of age. First the coal and then the stone trade drew his attention, and in them he became wealthy. He was also at the time of his death president of the Commercial Loan and Trust Company Bank.

Ex-Governor Oden Bowie, president of the Baltimore City Passenger Railway Company, died on December 4, of paralysis. He was born in Maryland in 1826, and had spent his active life in that state. He was elected governor in 1867, after having filled several political offices. Since 1873 he had been connected with the railway of which he was president.

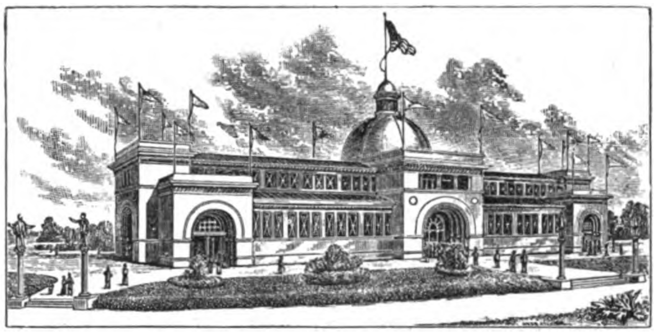
Mr. W. W. Smith, secretary of the Missouri & Kansas Telephone Co., died on December 28, at Kansas City. Widely known in telegraph and telephone circles, he will be missed by a large number of friends. Beginning life as a messenger boy he gradually rose to his recent position. His connection with the above company dates from 1884.

Baron Hermann Ludwig Ferdinand Von Helmholtz, born 1821, died 1894, an eminent physiologist and physicist. He graduated from the University of Berlin in 1842, and after several years in the army, into which his course of study had led him, he received an appointment as professor of anatomy and physiology at the University of Bonn. He devoted much time to the study of electricity and kindred sciences, and his investigations and discoveries were published from time to time. In 1871 Von Helmholtz was appointed professor of physics in the University of Berlin. His work and discoveries were of such importance that he was honored in 1873 with a degree of hereditary nobility from the German Emperor. In 1887 a physical technical institution was founded by the government, and over this Von Helmholtz was appointed to preside.

The Cotton States and International Exposition.

The industrial exposition of this year is to be that at Atlanta, Ga., which opens on September 18 and will continue until December 31. While it is held in the cotton states it is not intended as a local exposition but one that will embrace not only exhibits from the many countries of the western hemisphere but also from foreign countries as well. The industries that will be represented are all of commercial importance. The exhibits will be classified and arranged in such a manner as will bring allied industries together and benefit those interested in a special line of trade.

The buildings planned are sufficiently numerous to give each department a separate building with ample room for its accommodation. The accompanying cut shows the general design of the electricity building. A favorable location has been given it on the grounds, directly north of that devoted to transportation, and near the terminal station.



THE COTTON STATES AND INTERNATIONAL EXPOSITION.—ELECTRICITY BUILDING.

The building will be neat and substantial. While not elaborately ornamented it will be imposing in appearance. In size it is to be 91x250 feet, affording space for a large number of exhibits.

Piedmont Park, where the recent convention of the American Street Raitway Association, was held, is being transformed for the accommodation of the exposition. The excellent electric railways of Atlanta will afford the best facilities for transportation to the exposition grounds, the neighboring suburbs and the different parts of the city. With their assistance the suburbs will be able to accommodate many of the visitors to the city and thus relieve in a measure the pressure on the hospitality of the city.

The United States government has appropriated $200,000 for a government exhibit and the state government will make a generous exhibit of the products and industries of the state. The manufacturers of the south are preparing to make an extensive exhibit of southern manufacturers and communications have been received from many foreign governments promising support. Representatives of the exposition are already at work extending information and collecting exhibits.

Atkinson, Kan., recently celebrated the introduction of electric traction in that city. The street car lines formerly operated by horses are now run by electric motors. The citizens have been especially pleased with the change, and manifested their pleasure by a celebration.

Present and Prospective Development of Electric Tramways. *

BY C. J. FIELD.

It seems hardly necessary to review the past development of electric tramways; it has been made apparent on every side of us, commencing, it may be said, with the introduction of electric motors on a large scale on the roads of Richmond, Va., about seven years ago, by the old Sprague company. This was the first commercial undertaking of any size or capacity for the operating of a large service of horse railroad with electric motors, and the conditions and requirements under which this contract was taken were enough to discourage any but the most persistent and courageous. Grades of ten and twelve per cent, sharp curves, poor track to operate on, and no past experience to go by were some of the difficulties encountered. This road developed the system in its main features as it stands today, two motors being mounted, independent of the car body, on the truck, and driving to the axle by gear. With the improvements and modifications which seven years have brought into the field, this system stands in the main what Mr. Sprague made it at that time.

The first motors installed on this road were seven and a half horse-power each. Later on these were changed to ten horse-power, and a year or two later fifteen horse-power motors became the standard. Then twenty, and now two twenty-five horse-power motors are the standard street railway equipment which is generally made.

Street railway managers were soon attracted by the results there shown, and the next large system to follow Richmond was Mr. Whitney's then new consolidated system in Boston, the West End Railroad. There the Thomson-Houston company practically had the field for enterprise and experiment, and carried on still further the development which had been started at Richmond, working out still larger problems than had there been undertaken. The result is today that, outside of a few cable roads, there is not a street railway system of any size in the country where electric traction has not been or is not being now introduced on an extended scale, requiring enormous additional outlay of capital in this installation. There had been before the commencement of electric traction a growing demand for more rapid transit in large cities, and this had to be met some way. The cable had been introduced in a number of cases, but on account of its excessive cost, and special requirements and conditions to make it a success, in addition to the necessity of a heavy traffic in order to make it a commercial success, its introduction had been limited to a few large cities.

The advantage of electric traction was that it was equally available to the little cross-country horse line or the largest system in our large cities, and under the heaviest conditions of traffic and service. One of the first results of its introduction was the satisfying of the demand for more rapid transit, and the large increase in gross and net earnings, and the reduction of operating expenses, especially on the question of power. One of the early fields to be developed was the interurban service between cities, for connecting small towns with large cities. One of the first and most marked examples of this kind was the interurban service between Minneapolis and St. Paul. After its establishment it compelled six different steam roads to practically abandon the service they had been maintaining between these cities.

We have seen it in the last year or two carried still further at the World's Fair by its introduction on the Intramural road, and now being further extended on the elevated structures; and there are now being equipped one or two of the large steam roads for handling special problems, as, for instance, the Baltimore and Ohio tunnel at Baltimore, where the entire freight and passenger service of the road is to be handled by large electric locomotives of ten to twelve hundred horse-power capacity. The amount of capital and the confidence with which capitalists and investors have taken hold of the electric tramway has been something marvelous when we consider the short time they have been in service, and though you might find a few failures owing to poor management, over-capitalization, or some other sufficient cause, in general we find an uninterrupted line of successful extensions and enterprises in this line. I will try to make a brief general review of the different parts of the electric tramway system, and show the development which has been made in each.

There is probably no part of a street railway system which was more antiquated in its general construction than the majority of the road-beds were found in this country when cable and electric traction were first introduced, and it took some severe lessons in many cases to bring about appreciation of the necessity of good road-bed construction. The old horse-road construction was in somewhat the condition of the old steam-road construction fifty years ago, being a stringer construction, with ties four to five feet on centers in the majority of cases, and a flat rail, either center or side bearing, and weighing from thirty to sixty pounds to the yard, spiked to the top of the stringers. The result naturally reached with the introduction of electric traction on such a track, with its heavy service and severe wear and tear owing to self-propulsion, was a failure of the road-bed entirely.

Ninety-pound rail, being nine to ten inches in depth, enables them to be spiked direct to the ties and give the necessary depth for paving. This heavy rail, with eight to twelve-bolt joint plates, supplies every requirement.

We are hearing a great deal today about electrolysis and electrolytic action of the current on the return side of the tramway circuit. In the early introduction of electric tramways, and with the light section of rails, the usual method was to bond up the rails and connect them with the return copper or iron wire of varying sizes which was laid between the rails. With the introduction of seventy and ninety-pound section of rail we have met the question of sufficient capacity in the conductivity of the rail.

When we run across some of the old cases of line construction, as at Richmond and other places, and then compare them with the present form of construction which is now being introduced, it gives us a better illustration than words can describe of the improvement which has been made in overcoming the objections which existed in the earlier work. Now we have a well-built line, substantial in every respect. The poles used are either a heavy octagonal sawed pole, or various types of iron poles. Local city authorities, though, have compelled the use of iron poles in most cases, and various types of pipe and trussed sectional iron poles have been introduced.

Feeder wires have been more and more liberally introduced and used, and at present, on the best construction, the system is laid out and figured to maintain a distribution of potential over the entire system with a drop of not exceeding five to eight per cent under the most severe conditions or heavy stress of weather. Feeder wires in general have been run overhead, but we believe it is an assurance of better service on large roads to run the main feeder trunk lines in underground conduits, and we have done this in several cities with successful results.

In the old horse-car service the standard length of car body was fourteen to sixteen feet, and in open cars seven or eight benches. The added service done by the large electric roads brought about an increase in the length of cars, particularly in the closed cars. This was carried to an extreme, by increasing the length of the cars to twenty-six and twenty-eight-foot body, with double truck. We have had a reaction on that length, and we believe the best standard of car for heavy city traffic, and the one which will give the least wear and tear on the road-bed, and also will enable the use of higher speed on suburban lines, is a car body from twenty to twenty-four feet in length—twenty-one or twenty-two feet being the most desirable standard—and mounted on double trucks, with maximum traction on the driving wheels. Such a car body, with wide platforms —four to four and a half feet— with entrances on one side with wide double doors, fills best, we believe, the general requirements of such a service.

The improvement in motors during the past seven years, since their first introduction, has been marvelous. The old seven and a half or ten horse power motor was a thing of pity, poor in its design both mechanically and electrically,

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* Abstract of paper read before the American Society of Mechanical Engineers at its December meeting 1894.

and a continual worry and trouble to keep it in operation and service, the fields and armatures burning out every day, and the repair account on them running from three to six cents per car mile operated. Now if we turn to the present type of ironclad slotted armatures and waterproof motors, with normal horse-power capacity, in the general type of motors of twenty-five horse-power, making equipment per car fifty horse-power, and built for any speed which is practicable on the service for which they are to be used, with a depreciation, wear and tear less than almost any other type of power machinery, we have, it seems, attained a commercial stage and development in this motor which it will be hard to excel.

The one central idea of electrical engineers, in the early electric light and power station work, was to have the power station located in the center of the system, regardless of all other local conditions and requirements. Experience has shown us, in the broad treatment from an electrical and mechanical engineer's standpoint, that we want to take into careful consideration not only the electrical requirements as to the distribution of power, but also the possibilities of economical generation of that power from a steam engineering standpoint; therefore we give careful consideration at present to this matter. The general requirements are that a power station of any size or capacity should be so located as to generate, under the most economical conditions, the power which is to be used in the utilization of electricity, and the location to be such that the obtaining and handling of coal and water shall be at the lowest obtainable net cost. The capacity of the station should take into consideration the present requirements and immediate future expectations as far as can be foreseen, and as far as the resources of the company will permit on a commercial scale, and without depending too much on future prosperity.

The general basis of calculation of the horse power required for a tramway system must take into consideration the local conditions of service, grades, curves, etc., but, in general, fifteen to twenty-five horse-power per car equipment in use on the road is the general limit of a well-designed station, which will take into consideration the conditions for the continuous service and operation of the plant. A road of one hundred cars would therefore require about two thousand horse-power, which horse-power should be divided into say, four units of five hundred horse-power each. The number of units in any station should be the fewest number which will give a safe and economical division of the units, and in a station of this kind four or five units, according to the service and conditions, should be the standard. In the past we have had to be guided largely by the capacity and size of generators it was possible to obtain, but this question is now eliminated, and any capacity of generator which the engineer may call for and feel necessary to meet the needs of his case, can be contracted for and built with a surety of success. Generators are now being built in this country up to five thousand horse-power each. The general arrangement and character of power station building required for power plant is a well designed one story fire proof iron, brick and stone structure, with trussed roof, traveling power crane in engine room, and convenient for the handling of coal, ashes, etc., which it may be possible to obtain. The method of connecting up the engine and generators in the early types of small generators was to belt them to small automatic engines, or else by countershafting. Both methods have their advantages and disadvantages. At present the tendency is large generators directly connected to the engine, whether automatic or Corliss, high, slow or intermediate speed, such connection being made either by direct belting or directly mounting the generator on the engine shaft. The type of engine to be used on this service we have found must be equal in its requirements to that of rolling mill service, capable of standing the heaviest strains in the variation of the load, and also to give desirable closeness in regulation under these heavy changes, in order that our generators may be balanced with one another. There is probably no service which has done more to develop the steam engine in the last few years than railway and power service.

The old horse-car road in large cities operated at a total cost of from eighteen to twenty-five cents per car mile. One car mile is taken as the standard for operating expenses in our tramway service. The heaviest item in this operating expense was the question of power—that is, the care and maintenance of the horses, their feeding, and the depreciation of the same. The average life of a horse on a well-operated tramway road is five to six years, and the number of horses required per car from eight to eleven, according to conditions and requirements. The cost of this power service was from eight to eleven cents per car mile. This is where the electric road has made its heaviest gains in the reduction of operating expenses. This item is reduced in power service today to a cost, under general conditions, ranging from one to one and a half cents per car mile. Is not this a marvelous gain in a few years, and does it not indicate and show the possibilities of the introduction of this power on this service? The relative proportion of operating expenses to earnings in the horse-railway service was from seventy to eighty per cent operating expenses to gross earnings. In electric service we have a considerable increase in our gross earnings over our old horse line, which increase runs from twenty-five to fifty, and even one hundred per cent in some cases, and the operating expenses being forty to sixty per cent of the gross earnings. In this operating expense we include all the operating expenses of the road other than the fixed charges.

The cost of building and equipping an electric road is considerable. The last year or two has reduced this item to a considerable extent, especially on the electrical equipment; and has not only reduced the cost, but shows a great deal better equipment, and one which is going to show a much smaller depreciation than we had a few years ago.

Without going to extremes, I believe we may safely say that the electric tramways have more than met all the requirements, expectations and agreements of even the most enthusiastic advocate during their early introduction, and when we look around us today, and see the universal introduction which they have met with in this country, and are now meeting with in all parts of the world, we can in a measure appreciate what has been done in this matter.

As to the future and the future possibilities of the tramway, not only for city and suburban traffic, but also to enter into competition for a large share of the steam railway service, it will see the introduction of electricity for many purposes and uses in this field. The limit of speed and power obtainable is only limited by the conditions and local requirements of this service. Theoretically, any speed is possible which is desirable to be obtained on any service, and the only limits are the resistance of the wind or air. As to the exact line which this development is going to take, it is hard to determine; but we believe for a number of years to come it will be a continuance of the present lines, with improvements in the general detail of construction.

The storage battery we have left out of consideration entirely, and we do not believe it is in a state that it needs to be considered commercially as yet.

Up to the present time in this service, our development has been with direct or continuous current. There is no question but that, with the large improvements and modifications which are being made in alternating current apparatus, we may expect its introduction on the tramway service, especially for long-distance work.

In all this work the mechanical engineer has played and will play an important part, and the combined mechanical and electrical engineer is going to be and has been largely identified with the development of this line of work.

The oldest commercial newspaper in this country, Shipping and Commercial List and New York Price Current, has just entered upon its one hundredth year of publication. Its centennial number will contain a number of appropriate articles on notable events one hundred years ago. Old American business houses and the history of the commerce of New York are some of the subjects.

Electric Locomotives on the Baltimore & Ohio Railroad.

The introduction of electric locomotives on the Baltimore & Ohio railroad in the Belt Line tunnel at Baltimore has been watched with interest by the general public as well as electrical engineers. The progress of the work has been noted at times by the press, and the present stage of the work promises a speedy completion. These locomotives will be used exclusively in the tunnel and will haul freight as well as passenger trains. The locomotives and generating machinery are being constructed at the works of the General Electric Co., at Schenectady, N. Y. Two locomotives, one of 30 tons and another of 40 tons, have been constructed previously but have not been used on the important steam roads. This installation is the first practical step in the adoption of electricity on the steam roads. The use of these locomotives for the heavy service will be watched with interest.

The cab, which will be spring supported on the truck frame, will be of sheet iron and wood, and will have windows on all sides in order that the occupants may have an unobstructed view in all directions. Within the cab will be set up the series parallel controller, by means of which the movements of the locomotive will be at the command of the driver, and the air-pump, operated by a small electric motor, which will supply the air to the compressed-air brakes and the whistle. The locomotive will be also equipped with bells, safety devices, etc., and will have a Janney automatic coupler at each end.

From the illustration of one of the trucks it will be seen that the finished locomotive will be an imposing piece of electrical machinery. It will weigh in its completed state 95 tons, will be 14 feet 3 inches long, 9 feet 6¾ inches wide, and will be of standard gauge. The maximum speed will be 50 miles an hour. This will be reduced to 30 miles an hour when only half the draw-bar pull is exerted and to 15 miles an hour with full draw-bar pull. The average speed of the loaded train will be about 30 miles an hours. It can, of course, be run either forward or backward.

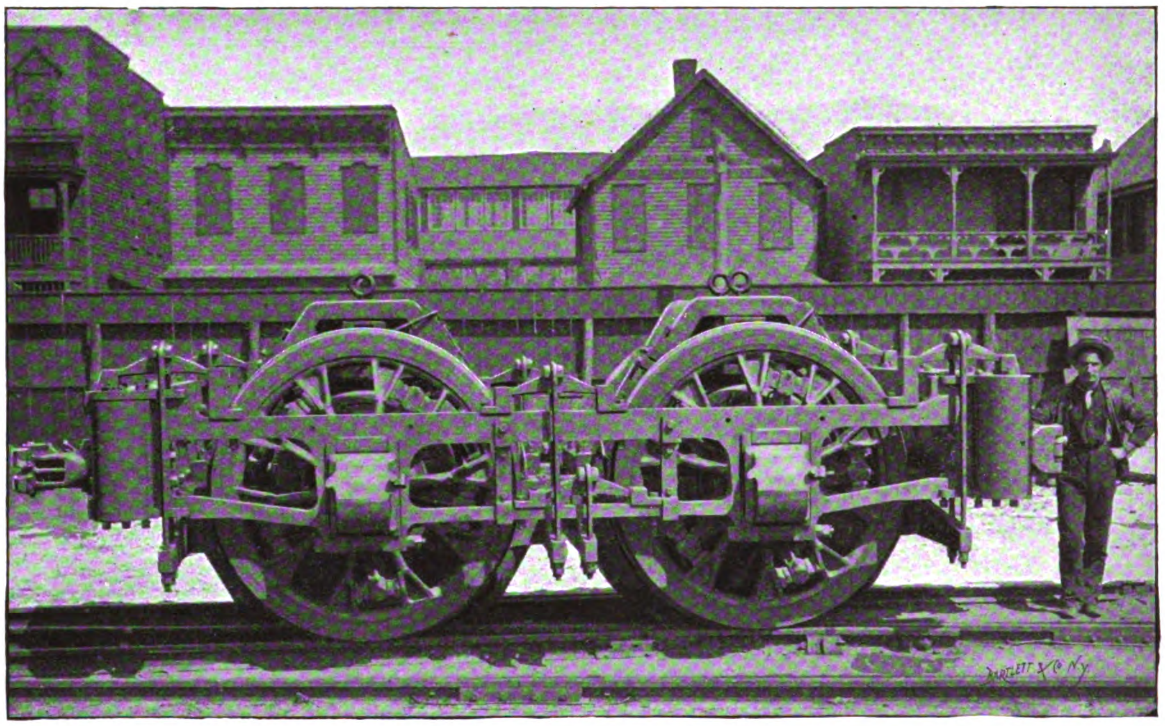


FIG. 1.—ELECTRIC LOCOMOTIVES ON THE BALTIMORE & OHIO RAILROAD.

The trucks are of forged iron, each resting upon four driving-wheels of cast steel, 62 inches in diameter. Flexibly supported upon each of these trucks are two six-pole gearless motors, one for each axle, transmitting their motion from the armatures to the wheels by means of an especially designed flexible coupling. The method of spring suspension has been carefully modified to allow of the immediate adjustment of the wheels to the irregularities of the tracks, and thus effect a diminution in the wear both to the motors and the track. The massive armatures are of the ironclad type. A hollow shaft service to carry the armature, and through this passes the wheel axle, to which it is connected by the universal coupling already mentioned which allows of freedom of movement in any direction.

The complete motors are the largest railway motors in the world, and while ponderous in appearance are by no means as bulky as might be expected from the heavy duty they will be called upon to perform. They are so set on the truck that they will be easy of access under all circumstances, whether the locomotive is at a standstill or in motion.

This locomotive is designed for heavy work, and will be called upon to handle trains as heavy as those now handled by the heaviest steam locomotives. A test of one of the completed trucks as shown representing one-half of the locomotive was recently made upon the tracks at the Schenectady works of the construction company. In order to obtain the necessary load a New York Central heavy six-wheel engine was made use of and the electric locomotive truck coupled to it. The machines were then sent in opposite directions and tugged at the connecting coupling as in a tug of war. The electric locomotive had a slight advantage over the steam engine in weight on the driving-wheels, and pulled it up and down the track with apparent ease. For the same weight upon the drivers it was shown that the electric locomotive will start a greater load than the steam locomotive, the pull being constant throughout the entire revolution of the wheel, the difficulty of variation of pull with the angle crank, as in the steam locomotive, being eliminated.

The test also proved that not only were the motors sufficiently powerful, but that the driving mechanism and armature couplings are amply strong to transmit the torque of the armature to the axle.

The power house is rapidly nearing completion and the generating machinery is almost ready for installation. The overhead apparatus, which has been especially designed to meet the extraordinary requirements, will shortly be in position, and before many months have passed the steam locomotive will have become a central object in the operation of trains in the Belt Line tunnel, which, untarnished by smoke and soot, will be brilliantly lighted by incandescent lamps.

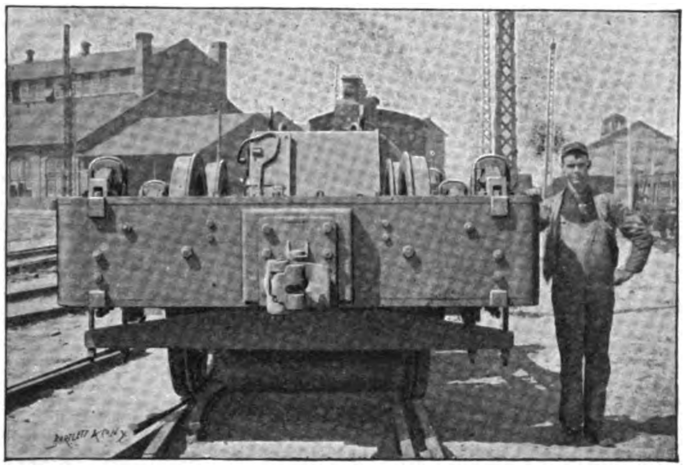


FIG. 2.—ELECTRIC LOCOMOTIVES ON THE BALTIMORE & OHIO RAILROAD.

The Henderson Drum Stop for Steam Engine Indicators.

In the accompanying cut is shown the Henderson drum stop for steam engine indicators. The cut shows the instrument with the movable or tension pulley, indicated at A, distended as in the act of taking a card. This device renders it unnecessary to detach the cord while taking cards. The hooking and unhooking of the cord, as every engineer knows, is a troublesome arrangement. The device can be attached vertically, in the position shown, to a metal or wood angle form, secured to the steam chest, or if more convenient, it can be attached in an inverted or horizontal position.

The cord is relaxed by raising the tension pulley, A, into line with pulleys, B and C. The cord is relaxed an amount equal to the amount required to rotate the drum. Distending the tension pulley, A, overhauls the slack of the card and starts gradually the drum from a state of rest to full speed. The change is effected at any speed of the engine in an almost imperceptible manner. The construction of the attachment is exceedingly simple but, nevertheless, very ingenious. The cord passes around the three pulleys A, B and C. The two pulleys, B and C, rotate upon fixed pivots while the third, A, is mounted on a movable carriage H. This carriage slides in a guide over a rack G and is held in position by a spring clip. Guard rollers I and I are placed above the upper pulleys and a lip on the carriage keeps the cord on the tension pulley. In using this device the cord from the indicator hooks to the small loop, on cord D. To the other end of the cord an elastic band is fastened, as shown, with one end placed over the pin of pulley, C. This holds the cord always in tension between that point and the cross-head on the engine. It prevents any possible whipping, snapping or entanglement of the cord. The instrument can be used either right or left.

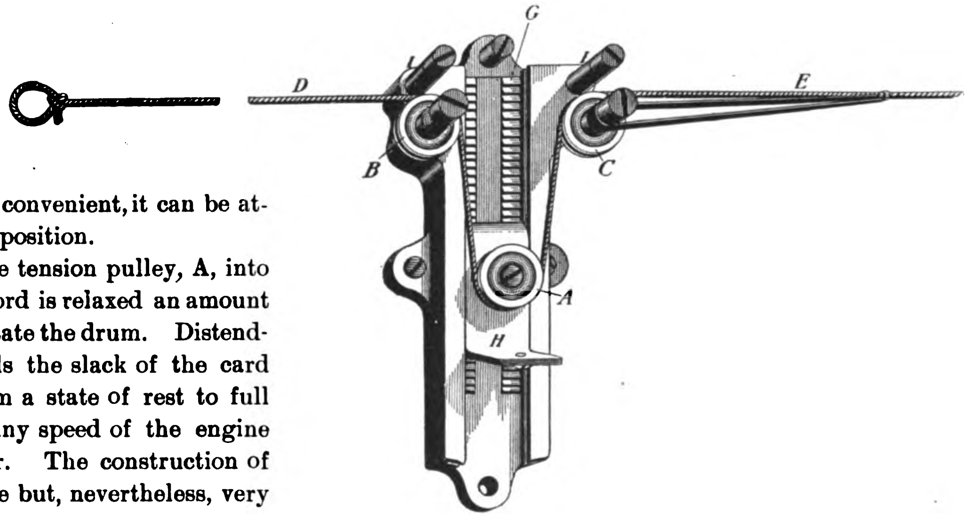
The drum stop is not large in size and can be packed with any indicator set. It is substantially constructed and will last an indefinite time. This handy device is manufactured by Queen & Co., Inc., 1010 Chestnut St., Philadelphia.

Electrical Plant in the Banner Mine.

An interesting electrical mining installation has been in operation for some time past near Oroville, Butte County, California, at the Banner Mine of the Development Syndicate, Major Frank McLaughlin, general manager. The particular interest applying to this installation is due to the fact that all the power required for both the mining and the milling of the ore, is electric. The power station is about two miles distant from the mine and mill, and water is obtained from the Feather river, under 112 feet head, operating two Pelton water wheels, which in turn drive two 85 horse-power direct current, 500 volt generators.

The power supplied by the generators is utilized in driving motors operating separately a 10 stamp gold mill, a rock breaker, a 10 inches by 20 inches Rand Air Compressor, and two pumps on the 300 and 500 feet levels of the mine, of the Knowles' Vertical Triplex, single acting type, one with plungers of six and one-half inches diameter, eight inches stroke, and the other of the same type with plungers of five inches diameter and 6 inches stroke. The hoisting works are also operated by an electric motor, and the mine and mill lighted from the power wires. Owing to lack of water for power the hoist has thus far only been operated intermittently, but a large bulkhead has recently been built, which will store sufficient water to allow of its operation at all times in connection with the other apparatus.

Mr. Frank McLaughlin, manager of the Development Syndicate, Limited, in a letter of recent date to Mr. Addison, of the San Francisco office of the General Electric Company, says the electric plant works perfectly and congratulates the representatives of the company on the success of the installation in the face of natural obstacles and mechanical difficulties that were seemingly insurmountable.



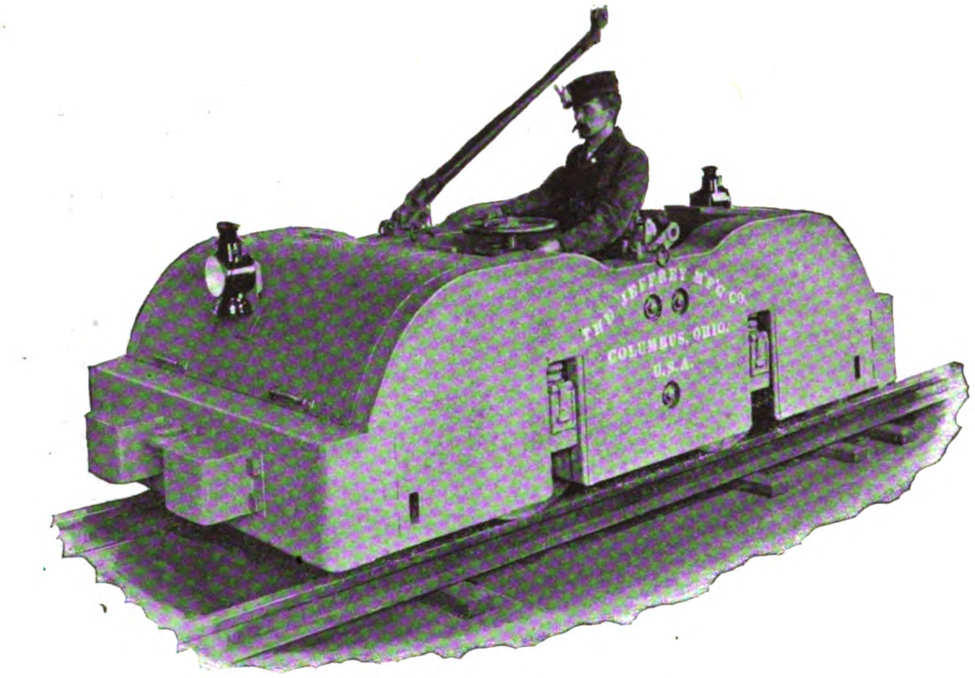
THE HENDERSON DRUM STOP FOR STEAM ENGINE INDICATORS.

Electric heating has been introduced on the Mont Saleve Rock Railway, Savoy.

An Electric Mine Locomotive.

The special advantages of electricity for the transmission of power in mines and for haulage has lead to its adoption in a large number of the mines. This number is rapidly increasing as the electrical apparatus is produced, such as this service requires. As the service differs greatly from that used above ground, the entire apparatus has been modified. In the accompanying cut is shown a new electric mine locomotive which has recently been brought out by the Jeffrey Manufacturing Company, of Columbus, Ohio. This company has had a long experience in the manufacture of machinery and appliances for mine use, and is fully cognizant of what is required.

This locomotive is said to fill all conditions necessary for successful mine work. It is compact in design, strong, simple in operation, and its parts are readily accessible. while every part is carefully protected from such injuries as are liable to occur in service. It is as fully protected against mishaps and accidents, such as would cause delays and shutdowns, as is possible. All parts are interchangeable and should from any cause a part become damaged, it is easily replaced, as all wearing parts are accessible.



AN ELECTRIC MINE LOCOMOTIVE

The locomotive illustrated is of 80 horse-power capacity, its draw bar pull is rated at 3,000 pounds at eight miles per hour, but on test on a dry rail it has shown a pull of 5,000 pounds, which can be considerably raised by the application of sand to the rail. It has therefore a very strong starting power which enables the motorman to start his train quickly and without sudden jerks or jars, which are liable to throw cars from the track or break the train in two. On a level track in actual service this locomotive has pulled at a speed of eight miles per hour, 65 cars weighing each 1,200 pounds and carrying one and a half tons of coal. The total load was therefore 136 tons.

This electric locomotive is made in three sizes, one as above stated, one of 40 horse-power and one of 60 horse-power. The weight of the largest size is something less than ten tons. The extreme length is ten feet six inches, width 64 inches for a 42-inch gauge, and height above rail 32 inches. Its wear on the track is light, and 30 pound rails afford a good track. A large part of the weight of the locomotive is supported on springs, and there is not consequently so much pounding of the track.

Its size permits it to be used wherever a mine car can can go. The wheel base is short, permitting it to go around short curves and through narrow passages. One of the great advantages of the electric locomotive over mules, is the fact that it can be used on narrow veins without cutting, where if mules were to be used, the roof would have to be cut out to give the necessary height. This work is very expensive and requires a considerable time which is in a large measure saved with the electric locomotive. Passages 42 inches in height will allow the motorman to pass without cramping.

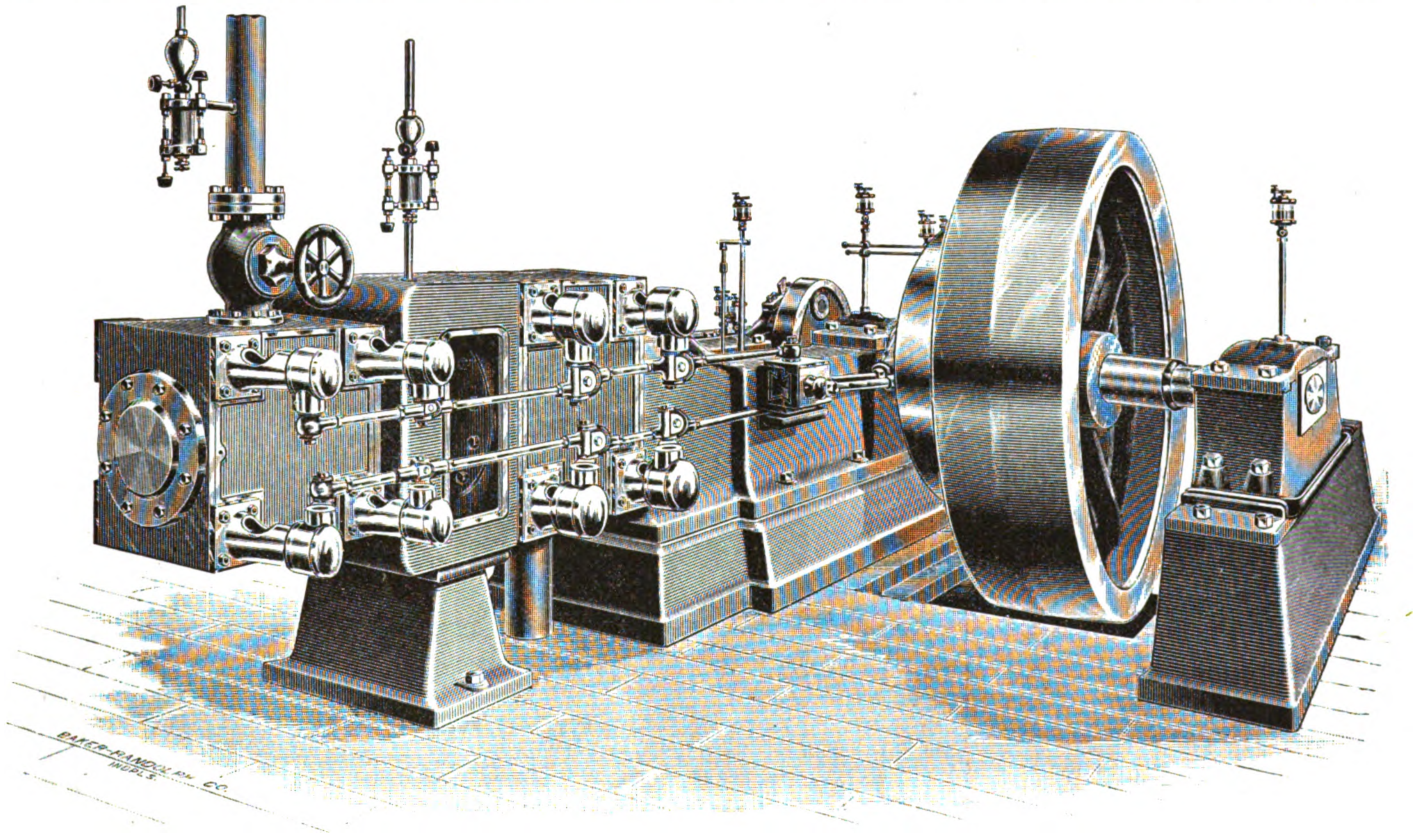
All parts of the electrical equipment are carefully insulated and protected from moisture and dust. The controlling apparatus is placed immediately in front of the driver's seat, and is so arranged that the regulation of the current and the application of the brakes is quickly and easily effected. The Jeffreys company has orders for a number of these locomotives from both anthracite and bituminous coal mining districts. Its machine shops are well equipped for the manufacture of this class of goods, which, together with their knowledge and long experience in the manufacture of mining machinery, gives them many advantages.

Electric Light in the New York Herald's New Building, Herald Square.

This establishment has one of the finest electric plants in New York. It consists of four large dynamos of 3,000 incandescent dynamo capacity and also several motors for various work. The most attractive feature of the whole electric plant is the fine artistic arc lamps in the press room. This is the only newspaper in America that exhibits its entire printing presses where the public can stand upon the side-walk and see the paper enter the press and come out printed and folded ready for delivery. For this establishment the question of light is an important feature. Over nine months ago, they began experimenting with arc lamps from incandescent current. All the makers of arc lamps were given an opportunity to place their lamps on trial in this room, and they availed themselves of this invitation with great promptness. After nine months of trial the Clark Electric Company's lamps were selected as being the best in every respect. The Clark company had a special fixture made for the purpose which comprises a combination of electric arc light and gas, the gas to be used when electricity is not needed. A visit to the Herald, Broadway, Sixth Ave., Thirty-fifth and Thirty-sixth Sts., will be time profitably spent.

Cycloidal Heavy Duty Engines.

The cycloidal heavy duty engines have been offered by the Atlas Engine Works, of Indianapolis, Ind., to meet the most exacting requirements and promise the economical use of steam and satisfactory service. The type of engine is offered as examplifying the latest ideas of steam engineering. At the present time the demand of steam users is for economy of service combined with strength and durability. The coal pile must be replenished less frequently and the plant must operate with the least possible expense for repairs and renewals. This demand has been kept in mind in the production of this line of engines.



CYCLOIDAL HEAVY DUTY ENGINES.

The accompanying illustration shows the tandem compound engine. The cut indicates the general design, the arrangement of the valves and method of operating. Each cylinder is four valved with the shortest possible ports. They are enclosed with live steam jacket to prevent condensation. The valve seats and cylinder lining are removable for inspection or renewal. The steam valves are multiported with flat surfaces. They are closely fitted, have short distance to travel and are quickly opened. They can be removed in few minutes and as quickly replaced.

The exhaust valves have a positive motion, being operated by a fixed eccentric. They are multiported and are removable the same as the steam valves. The valve gear has no trips or dash pots. Rods direct from the governor and two eccentrics in lateral motion simple cycloids for the steam valves and cranks for the exhaust valves. All parts are of steel made to a standard pattern and smooth finished. They are boxed in oil, the duty is light and the wear scarcely perceptible after long service. Every pains are taken in the construction of these parts to make them as perfect as possible.

The governor is of the inertia wheel form and controls the light valves with practically no variation in speed. The main bearings are large and of a special construction, which gives them good lubrication. The frictionless journal box can be taken out by simply jacking up the shaft and wheel. The connecting rod is a heavy rod, the special feature of which is the strap. This is built up of two sides and one end piece. The tenons on the ends take the strain, while the bolts hold the parts together.

Special lubricating devices are provided to oil the various wearing parts of the engine. The base of the engine is broad and substantial and the large sub-base, provided also for the outboard pillow block, gives the engine a substantial foundation and a neat appearance. This engine is also made in the simple or single cylinder type. In the tandem form the relative sizes of the cylinders are changed to meet the requirements of the steam pressure used. In operation a range of speed and pressure from 25 per cent below the rated capacity of the engine to 25 per cent above can be obtained without producing results beyond the limits of good economy. The Atlas engine works has excellent facilities for the production of both engines and boilers and its manufacturers are well known to the trade. This type of engines may be expected to fill the claims made for it by its makers.

Last month the plant of the Edison Electric Light Company at Oskaloosa, Iowa, was destroyed by fire. The loss is estimated at about $15,000. Being the only plant, the city is without electric lights.

New Multipolar Generators and Motors.

In the accompanying cut is shown the new type of multipolar generators and motors recently placed on the market by the Commercial Electric Company, of Indianapolis, Ind. The design, as it will be noticed is neat, compact, and gives evidence of mechanical strength. They are slow speed, require a small floor space, and are especially designed for light and power service.

The armatures, which are of the smooth core, Gramme ring type, are made of a special grade of iron, having a minimum hysteresis loss, and the absence of teeth entirely does away with eddy currents in the pole pieces and the sparking, due to high self-induction of the cores. The armatures are thoroughly ventilated, and this, together with the large croes section of the conductors and the freedom from core loss, obtained by the above construction, results in a very low rise in temperature. Each coil of the armature is entirely independent, and if damaged can be renewed without disturbing any of the others. The commutator is made of the hardest copper and clear sheet mica insulation and the great useful depth of the segments permits of turning it down many times without necessitating renewal.

The magnet frame is of cast steel of the highest permeability, and is mounted on a broad cast iron base, that carries the bearings. The bearings are of the sperical, selfaligning type, and are provided with oiling rings, which dip into an oil reservoir of large capacity, so that frequent renewals of the oil are avoided. The bearings have phosphor bronze linings, with a large bearing surface. The pulleys are of large diameter and have ample belt surface, so that the full power of the machine may be transmitted with but light pressure on the bearings, due to the belt pull.

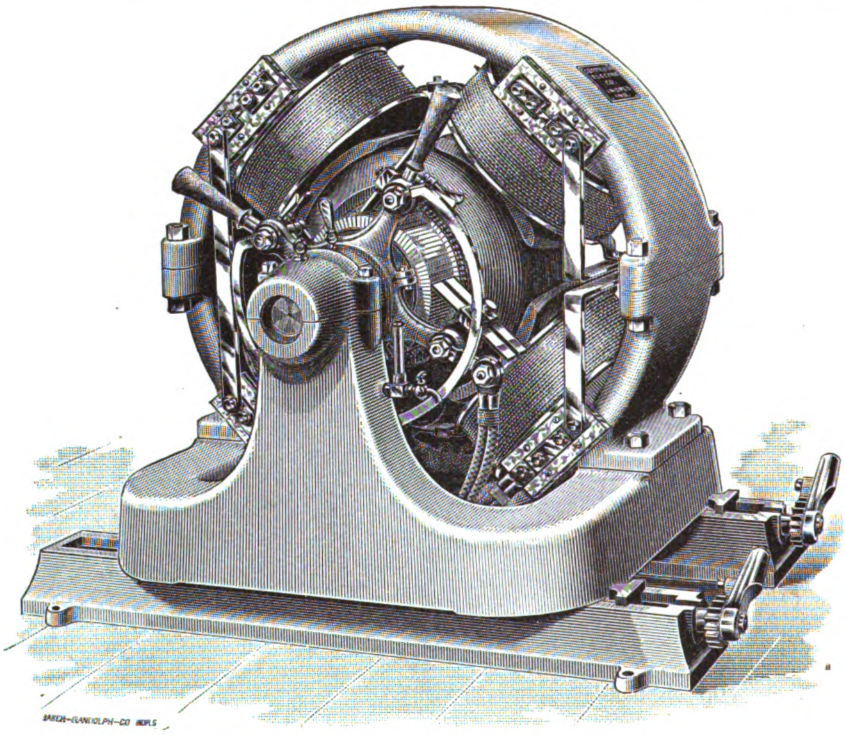
The field coils have a large radiating surface, and thus run at a very low temperature. They are easily removed, and the series coils are placed at one end of the spool, so that either the series or shunt coil can be repaired without disturbing the other. The brush holders are mounted upon a rocker arm, and have independent adjustment of position and tension. The insulation is of the highest grades and will withstand a pressure of 5,000 volts between the windings and the frame.

The machines are built in sizes from 40 to 100 kilowatts, and are adapted for belt driving or direct connection. Their ability to withstand the sudden fluctuations of load and the severe temporary over-loads peculiar to street railway work, make them especially valuable for that purpose. On their construction skilled mechanics are employed who are familiar with both the mechanical and electrical requirements of the machines. All parts are made from standard patterns that make them of a uniform size. During the past few months a number of these machines have been installed both for lighting and power work, and an excellent service is reported.

An international exposition is to be held at Amsterdam, Holland, this year.

Cast Welding Rails.

A new method of rail welding for welding the rails of street railways has been introduced by the Falk Manufacturing Company of Milwaukee. It is termed cast-welding and promises to be an active rival of the electric welding process. The outfit used consists of a cupola mounted on a wagon truck, together with a small boiler and engine for operating the blower which furnishes the air blast to the cupola. In making a joint the paving and earth are first removed from about the rails; the ends of the rails are then cleaned and the molds fastened in place. A number of joints are prepared in this way, the molds being hot when applied. The metal is then drawn from the cupola and poured in the moulds from a ladle. The union which takes place is similar to that which takes place in an ordinary weld. Samples from joints which have been broken up for inspection show that the weld is uniform throughout. The moulds and other parts of the equipment are so constructed that they are easily handled. The moulds are left in place about ten minutes to allow the metal to cool before being removed. Every alternate joint is first welded, and after the rails have cooled the remaining joints are welded. This plan is followed that there may be no bad effects from the rapid expansion and contraction of the track, the rails being heated for a considerable distance each side of the joint. The cost of a joint is said to be about three dollars, and 60 joints are made in a day at St. Louis, where the process is being tried. The company will soon have completed several outfits, which will have a capacity of from 140 to 200 joints a day. One of the advantages of this process is the comparatively low first cost of outfit, being within the means of almost any road.



NEW MULTIPOLAR GENERATORS AND MOTORS.

A fire broke out in the factory of W. H. Fleming, the manufacturer of the Fleming patent woven wire dynamo brush, on Christmas eve, doing damage to the extent of about $1,700, partly covered by insurance. Work will be continued without interruption during the restoration of the damaged portion of the building.

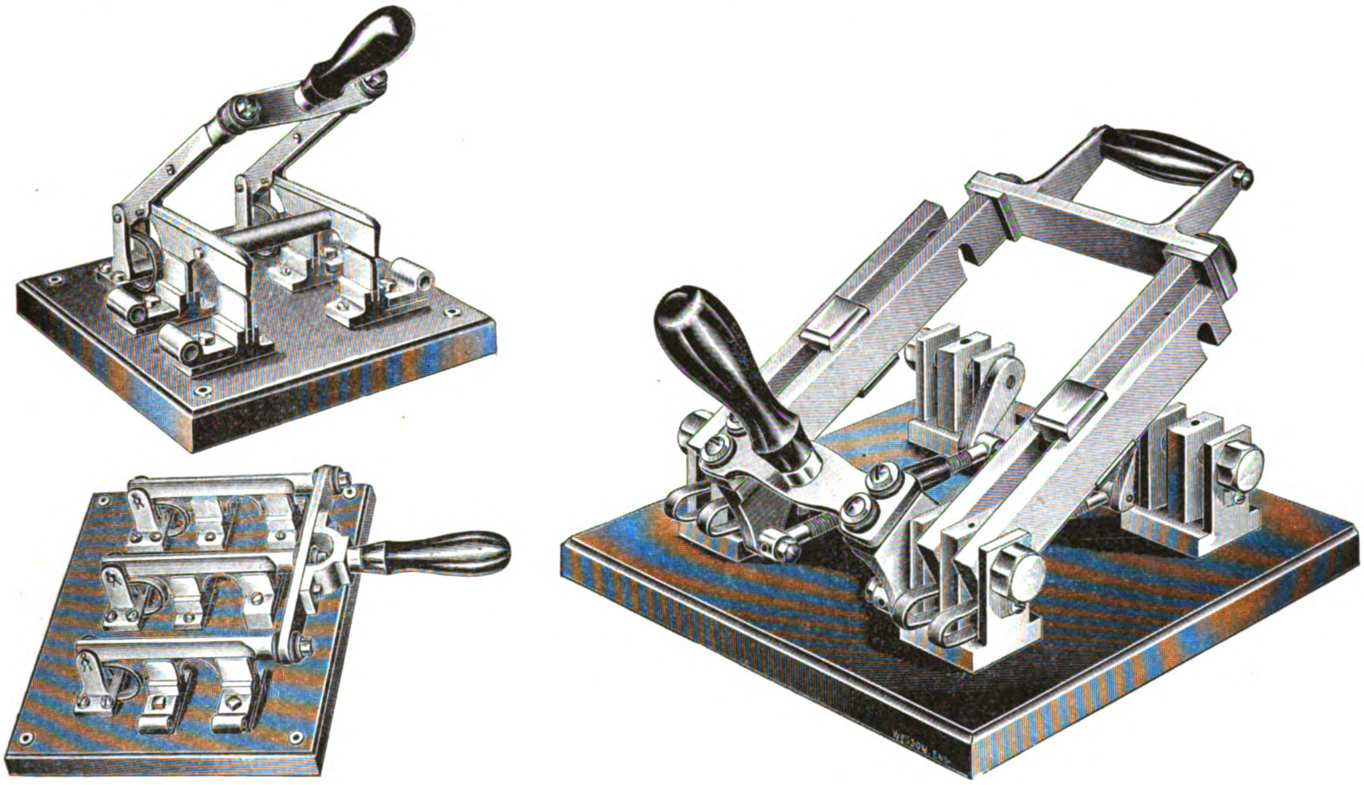
A New Line of Switches.

In the accompanying cuts are illustrated a few of the switches recently placed on the market by Linton & Southwick, of Worcester, Mass. The switch shown in Fig. 1 is the bolted contact switch, designed for heavy currents. The minimum size of this switch has a capacity of 500 amperes. As will be noticed by reference to the cut, the distinguishing feature of the switch is the method of tightening the contacts when the switch is closed. The resistance is greatly reduced by means of the clamping of the jaws and switch blade after making contact.

The opening and closing of the switch is effected with ease as the excessive friction is reduced when the switch is opened. When the switch is closed the jaws and blade form one solid connection, but as the handle is raised the grip is loosened. The friction necessary in other forms in order to get a good contact, is obviated. Attention has been recently called in a number of papers read before electrical societies to the amount of power lost in poor connections. These switches are a step in the direction pointed out, and insure a saving in the power lost in loose switch contacts. As every one knows who has investigated the matter, the leaks in a system soon take a large portion of the power. They cannot be overlooked. Many managers will find on their switchboard and in the switches and connections the reason why the plant does not pay dividends.

These switches are strong and well put together. They give evidence of great durability and are of a convenient form for switchboard or for a service switch. This is but one of an extensive line of switches made. Figs. 2 and 3 show the quick break and the three-pole single throw switches. They are simple and effective in service and have no weak points to quickly wear out. The springs of the quick break switch are not of the spiral form, but simple flat springs seated in the base. It causes the lower section to fly back instantaneously when released from the jaws.

Other switches are made in sizes from 25 to 1,000 amperes, for both high and low tension. Fuse connections are also furnished with the switches when desired. New methods of mounting are employed, and when placed on base a neat, trim appearance is given the switch. The metal used in these goods is selected for its conductivity and in putting it together strength is not overlooked.



FIGS. 1, 2 AND 3.—A NEW LINE OF SWITCHES.

Feeders to Railways.

Continental Europe has a large mileage of narrow gauge railroads, or light railways as they are called, which are used as feeders for the wider gauged trunk lines. In England where railroad construction is especially expensive, over $200,000 per mile or three times the cost in this country, the subject of building light railways as feeders has been extensively discussed and the British board of trade has appointed a committee to look into the matter and report upon the advisability of establishing a system throughout the country. Light railways have been tried in America and found wanting. Twenty years ago there were many narrow gauge roads; here now there are few indeed. The cost of transshipment from car to car at junction points proved more expensive than the added cost of construction.

It is quite likely that a net work of railroad feeders will be built up in the United States. They will be electric lines. They will be much cheaper in construction, for electric motors can climb all sorts of grades. Expensive cuts and fills need not be provided for. The field for the profitable construction of these electric lines is almost limitless.—Industrial World.

Judge Seaman on December 28th dissolved the injunction restraining the Sunbeam Incandescent Lamp Company from the manufacture of incandescent lamps. The injunction was dissolved because of the expiration of the Canadian Edison patent. The motion for the dissolution of the injunction as first made was denied but being again presented in a different light was granted.

Sweet Automatic Magnetic Limit Car Switch.

It is not the ordinary wear and tear that worries the railway manager but the unexpected, the accident that strikes the unprotected points and increases enormously in an instant the expense account. The brake shoes are expected to wear out in a short time, the boxes to need new brasses and other parts to need renewal, but the motors and electrical equipment are expected to do service for a long period, their high cost requiring such service before yielding an adequate return. When suddenly burned out or damaged the loss is heavy, and often comes when the company is least able to stand it. It is these accidents to station or car equipment that brings the gray hairs to the manager's head.

The study of the matter of protection has been continued since the practical adoption of electricity and has been found a most difficult problem. The fusible wires have been found unreliable and apparatus founded on the same principle has not been successful. There has been, however, developed by the Sweet Electric and Manufacturing Co., of Grand Rapids, Mich., a line of apparatus which affords to the electrical equipment the protection required. In the accompanying cuts is shown the non-arcing limit switch especially adapted for street railway motors. It takes the place of fuse boxes and for double equipments can be put in circuit with each motor so that if a ground or short circuit occur, the non-arcing limit switch cuts out the defective motor, leaving the good motor still in circuit for operation.

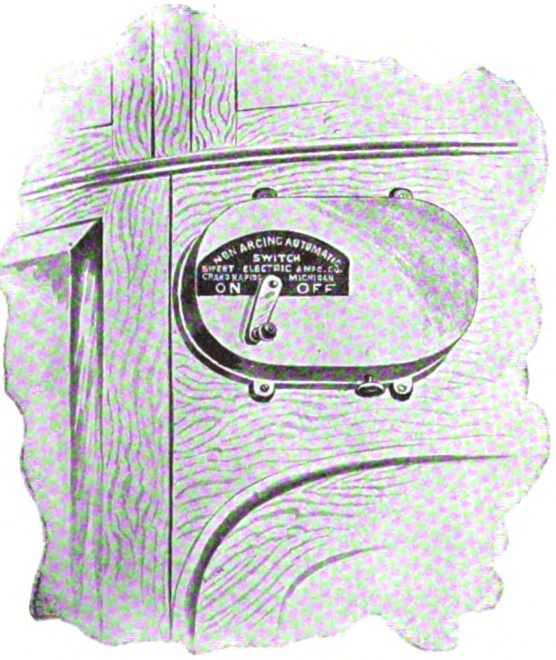


FIG. 1.—SWEET AUTOMATIC MAGNETIC LIMIT CAR SWITCH.

The switch protects not only the car but also the power-house equipment. With many cars running, each is a part of the large system, and when one car is disabled, if not cut out, all other cars are affected. With the non-arcing automatic limit switch when grounds or short circuits occur, the motor equipment is isolated from the rest of the system. When an excessive current reaches the switch it is stopped, the motors are protected and no shock is conveyed to the station. Circuit breakers have been found more reliable than fuses, since fuse wires will allow a large amount of current to pass in excess of their rated capacity. Thus it is customary to protect motors with from 50 to 75 amperes fuse in circuit, and if from any cause a short circuit or ground should occur with an abnormal rush of current, the fuse will carry momentarily 250, 300 or 500 amperes without fusing. The circuit breakers at the station will be opened and all cars on the system will be brought to a standstill. The limit switch, however, is sensitive and accurate and acts quickly. The single car is cut out before any part of the system is affected and the station is protected from all interruptions.

This switch permits the motors to be cut out of circuit while allowing the lights to burn. The sudden change from light to darkness and vice versa is unpleasant to the eyes and in many places is unsafe. The switch is not large being only three by eight by eleven inches in size. It takes up no valuable space, and can be placed in any convenient place either within or outside of the car. Although very sensitive it cannot be opened by any sudden jar, but opens only when released by a rush of current. This switch, together with the station limit switch, forms an important set of protecting apparatus.

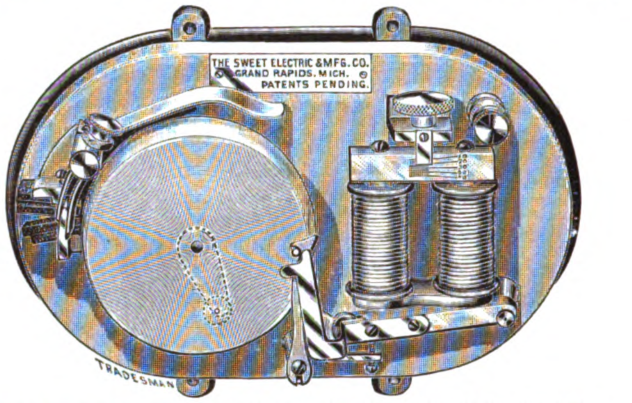


FIG. 2.—SWEET AUTOMATIC MAGNETIC LIMIT CAR SWITCH.

ODDS AND ENDS.

The well-known electrical supply house of E. S. Greeley and Company, at 5 and 7 Dey St., New York, was last month badly damaged by fire. The loss was considerable on the extensive stock carried.

The Lake St. Elevated Railway, Chicago, it is reported, is to be changed the coming season to an electric road, and will receive power from the new power-house of the West Chicago Street Railway, on Western Ave.

One of the many ingenious electrical devices which German inventors have brought out, is an electric light fastened in the bridle of carriage horses. The lamp is enclosed in a silver reflector, and is connected by wires with the storage battery in the carriage. The wires are very flexible and are concealed in the harness. Such lights are said to be now quite common in Berlin.

A plan to utilize the power of the Susquehanna has been perfected, and according to the press dispatches, a company has been formed to build dams, erect electric power stations and furnish electricity to customers. Well-known Baltimore and Philadelphia capitalists have formed the Susquehanna River Electric Company. The company contemplates furnishing power to a number of street railway systems in the neighboring cities and light in the intermediate towns. It is estimated that 40,000 horse-power can be obtained and for this amount expect no difficulty in securing customers. It is also reported that several individuals are interested in this project who are connected with the long distance electric lines which have for a long time been contemplated in that locality.

A Successful Municipal Plant.

When the electric light commissioners of the city of South Norwalk, Conn., made their first annual report they were congratulated on the success of the year's run. The report just rendered of the past year shows an even more favorable result than the previous year. The cost of operation and maintenance has been reduced nearly ten per cent. The report shows a careful management and a close scrutiny of all expenditures. The lights have been operated on the same schedule, starting at dusk and burning till 1.30 or 2 A.M. on all nights except clear moonlight nights. The lights are also burned all night on the Fourth of July night and on such other occasions as in the opinion of the commissioners it may be advisable.

There are ninety-nine arc lamps in use for lighting the streets; these are so equipped that they can be adjusted to burn at 1,200, 1,600 or 2,000 candle-power. The cost to the city for each of these lamps for the year was $59.29 against $64.53 for the previous year. These figures include interest on the cost of plant, buildings and real estate and an additional five per cent on the cost of equipment for depreciation. The indications of wear and tear on the apparatus after two years' use is very light. But after a number of years, although kept in good repair, the effects will be more noticeable and the cost of plant is thus distributed through the different years. The plant has been very fortunate in the matter of accidents, having been so far entirely free. Lightning has troubled little the equipment, which is well protected by lightning arresters.

A great saving in expense for fuel is reported by mixing one part locomotive sparks with two-parts first-class bituminous coal. The cost of running the lighting system for the past year is given in the annual report just issued, as follows:

New construction	$ 193.08	
Repairs	109.31	
Tools and equipment	83.46	
Running expenses	1,862.93	
Salaries	2,400.00	
Total expenditure for the year		$4,648.78
New construction forming part of original equipment	$193.08	
Supplies on hand	300.00	
Total amount deducted		493.14
Actual operating expenses for the year		$4,165.54
Depreciation on apparatus, etc., $15,200 at five per cent		760.00
Interest on appropriation $22,500 bonds at four per cent		900.00
Total cost of operation		$5,815.64

In connection with the report the commissioners have also prepared some statistics showing the size of plant and system together with amount of fuel, oil, etc., consumed. This data has been well worked out and will be found valuable for comparison:

Capacity of plant in 2,000 candle-power lamps	120
Number of circuits	2
Miles of wire in circuits, about	15
Lamps in circuit	99
Lamps in regular service	98
Lamps in irregular service (council room)	1
Lamps added to system during year	2
Capacity in lamps for future increase	21
Extra lamps on hand	3
Average distance between lamps in feet	500
Average lamps in service during year	98
Average candle-power per lamp	1,400
Average number of nights lighted during year	309
Average cost per lamp per night (interest and depreciation excluded)	$ .13$\frac{7}{10}$
Average cost per lamp per night (interest and depreciation included)	$ .19$\frac{2}{10}$
Average cost per lamp per year (interest and depreciation included)	59.29\frac{3}{10}$
Average cost per lamp per year (last report)	$64.53¼
Average pounds of coal per night	2,282.5
Average pounds of coal per night per light	23.29
Average pints of cylinder oil per night	1.68
Average pints of engine oil per night	.75
Average pints of dynamo oil per night	.37

South Norwalk is a city of between 5,000 and 6,000 inhabitants, and is located on the New York & New Haven railroad, in the southwestern part of Connecticut. Its advantages for procuring supplies of all kinds, although good, are not exceptional, and the success of this plant must be attributed to its management, which does not seem to have the defects usually apparent in municipal enterprises. The plant was planned and installed under the direction of Mr. A. E. Winchester, consulting engineer and at the present time a member of the board of electric light commissioners.

Three commissioners were appointed by the city who should have charge of the erection of a station and the purchase of the equipment for lighting the city by arc lamps. These commissioners are now elected one each year for a term of three years. The commissioners the past year were Messrs. Leslie Smith, Joseph A. Volk and A. E. Winchester, the latter's term expiring January 1. The operating force of the station consists of a superintendent, an engineer and a trimmer and lineman, with such extra help as occasion may demand.

The building constructed on the site secured for the station is a substantial brick and fireproof structure. The roof is slate and has cupolas for ventilation. It is close to the railroad tracks, convenient for the delivery of fuel. The building is divided by a fireproof brick wall into two parts, each 40 by 32 feet. In the first are located the engine and dynamos, and in the second the boilers, feed-water heater, storage for coal, etc. The ceilings are high and the rooms are well lighted. The engine is an Ideal of 100 horse-power and drives two 60-light Western Electric arc dynamos.

The boiler is of 125 horse-power, set with a Weitmeyer patent furnace. The stack is of iron, 33 inches in diameter and 70 feet high. The station is also equipped with fire hose and numerous other appliances. A portion of the building is also fitted for an office, and another part for a workshop and storeroom. The building is large and will accommodate more than double the present equipment. The lamps are carried on two circuits, which leave the station by way of the cupola over the engine-room. The majority of the lamps are suspended over the street intersections by span wires, and the remainder from mast-arms or on pole-tops. As arranged the streets are well lighted and the service satisfactory in every respect.

What Electrical Business Men Think of Business For 1895.

The year just past will not soon be forgotten. It opened under a cloudy sky, which has only been partially cleared toward its close. The uncertainty of the tariff question, the inactivity of congress, unmindful of the condition of the country, and the strikes and labor troubles during the first half of the year were anything but encouraging. The settlement of these questions, the favorable result of the November election and encouraging reports from different sections of the country toward the close has given a brighter look to the business situation. Thus 1895 finds a more hopeful feeling among business men. The past has taught its lessons, the future promises its reward. The recovery so far has been slow but a healthy, substantial growth is what is desired. The sound, well managed business houses have weathered the storm and are recovering their former strength with the improvement of business. Probably no better evidence of the feeling of the business men in the electrical industries can be given than the following letters received in response to a letter sent out a few days ago:

"The outlook so far as we are concerned is very bright and we have every reason to believe that the coming year will witness a general revival in all branches of trade. During the last three months the improvement in business with us has been of such a character as to warrant the belief that it presages a return to "good times all around."

C. M. Wilkins,
Partrick & Carter Co., Philadelphia.

"We believe the business prospects for the year 1895 to be very encouraging and favorable. Our experience has been an extraordinary exception to the common rule, our business having been larger in 1893 than in any previous year and about 15 or 20 per cent larger in 1894. . . . . We fully expect to be as busy in 1895 as we were in 1894, which means that we shall have to run our factories night and day continually. It is our opinion that the electrical industries of the country have stood the test of the long financial depression remarkably well. . . . . "

Standard Underground Cable Co.,
J. W. Marsh, V-Pres. & Gen. Mgr., Pittsburgh.

". . . . If inquiries would only amount to trade I should say that the prospects were brightening very much, but in the past two years I have seen so many hopeful signs blasted that I shall not be sanguine of better business, until we have the orders on the books." R. Humffreys-Roberts,
Secretary and Manager.
Fontaine Crossing & Electric Co., Detroit.

" . . . . The demand for electrical apparatus came more quickly on the eve of the revival than other lines, probably for the reason that a large number of customers had put off for the past year the buying of electrical apparatus. The returns for October, November and December show a marked improvement over the previous six months. The outlook for 1895 is most favorable, judging from the amount of inquiries. . . . . " J. Holt Gates, Chicago.

"Indications seem to point to something of a revival of business during the coming year. Among other things it might be noted that the unusual holiday trade in general lines is certainly a favorable sign, and shows a feeling of returning confidence, which we trust means business."

T. I. Stacey,
Secretary and Treasurer.
Electric Appliance Co., Chicago.

"As to my opinion of the business situation and outlook for the coming year I beg leave to say that it appears to me that the events of the year which is now drawing to a close, have been valuable in many respects and have greatly improved the prospects of conservatively managed electrical supply houses in this city, all of which I believe are now in a more satisfactory condition than ever before, the law of the survival of the fittest contributing thereto. In scanning the horizon for signs as to the prospects for '95, a cloud is noticed, which although not perhaps any larger than a man's hand, still in my opinion, portends uncertainty and possible disaster. I refer to the currency question, which I consider one of the foremost and important questions with which we have to grapple. Should this problem be solved and disposed of on a sound basis, I believe we would enter on an era of business prosperity of a substantial character, such as we have never experienced. I confess to not being hopeful for an immediate solution of the question, owing to the political situation, but firmly believe that the subject will receive proper treatment in the next Congress which meets December, 1895.

Geo. A. McKinlock,
President, The Central Electric Co., Chicago.

"As to how the electrical industries have fared during the past two years can say without the slightest hesitation that we have felt the depression fully as hard as the average business and that prices have steadily tended downward. As to the outlook for the new year everything in our opinion hinges upon the outcome of the currency agitation now engrossing the attention of congress, the administration and the country generally . . . . Any financial policy which discriminates against the producing sections of the great south and west must naturally react upon all industries in the remaining sections. What we want is not experimental legislation but a speedy return to a bi-metallic standard. If congress will so act, in our opinion, prosperity will be immediate and permanent."

W. L. Waples,
President, Jenney Electric Motor Co., Indianapolis.

"I beg to state that the business prospects for 1895 from our point of view are most excellent. All of our departments are working at high pressure to fill orders which have been coming in almost too fast for the facilities at our command. . . . . If we were asked how we were doing we could reply: 'Never better, thank you.'" J. McGhie,
General Electric Co., New York.

"It seems to us that the electrical people have stood the test of the long financial depression fully as well as any other branch of business. While the volume of business has largely increased, the profits have steadily decreased under pressure to make sales, until same have reached the limit of safety, requiring the outmost diligence and economy to get a small return for the capital and labor invested . . . . The illusion is fast being dissolved that the electrical business is more profitable than other lines and for this reason it is assuming the normal conditions required to make any business successful—brains and money."

E. V. Cherry,
President,
Standard Electrical Works, Cincinnati.

"I believe that the coming year will see a very great revival in the electrical business in fact we have already begun to feel the return of activity especially in the street railway business as well as in the lighting and power work. . . . . The electrical business, in my opinion, has suffered less by the financial depression than any other manufacturing industry in the country."

S. H. Short,
The Walker Manufacturing Co., Cleveland.

"The prospect for the coming year is very encouraging. The business throughout is being conducted on sound commercial principles with a tendency toward a better margin of profit and a greater volume of business. The electrical industry has stood the financial depression equally as well as other branches of trade considering the enormous growth of the business in the past seven years. . . . . The demand for the future will be for the best and most reliable apparatus and construction that electrical and mechanical skill can produce. The electrical journals can help the industry very much.

James H. Seymour,
President,
The Clark Electric Co., New York.

"The electrical business of the country is improving slowly but surely. We think that the electrical industries have stood well the test of the financial depression and have taught us all lessons which will render the panic a benefit rather than otherwise."

W. A. Hough,
Secretary,
The Brush Electric Co., Cleveland.

"While our business for the past year has been very satisfactory we anticipate for '95 one of the best years we have ever had, as we think there will be a great number of central lighting plants installed which means the use of a large number of electroliers. We are of the opinion that where electrical industries have been founded and run on sound business principles, they have not suffered more than other lines of trade . . . . "

W. S. Edwards Manufacturing Co.
Frank S. Beardslee, Secretary, Chicago.

"We anticipate a very active business during 1895. Our inquiries were never more numerous than now, and our fall business has been fully 30 per cent better than 1893. There is no reason why this condition should cease with the advent of the new year. We are well satisfied with the net profits of 1894 and would not sell the prospective profit of 1895 for this year's earnings. . . . ."

Chas. E. Gregory,
President,
Chas. E. Gregory Co., Chicago.

"We have to say that in our judgment the business prespects for 1895 are for a small advance over those of '94. Improvement is in evidence but it will be slow. . . . . Activity in machinery manufacturing however, can only come after an improvement in consumptive demand in other lines. Street railway work promises considerable activity but many of the projections that are talked of have nothing to recommend them; too much wind and water."

Jas. McBrier,
President,
Ball Engine Co., Erie, Pa.

"It strikes me that the indications are very encouraging. The indications referred to embrace favorable reports from architects and general contractors who claim a large volume of important work in sight for the coming spring, and when the building trades are active, it means better times. We do not look for any immediate change in existing conditions before March or April, but everybody seems hopeful and there is a healthier tone to business inquiries, all of which lead up to the above conclusions."

S. F. B. Morse & Co.
per S. F. B. Morse, Chicago.

"We consider the prospects for a large business for 1895 most excellent. . . . . While we with others have suffered in the falling off of sales in the past year or two, the sales in our electrical department have steadily increased, and the year that we are just ending shows a larger sale of our insulating materials than ever before, which is very gratifying. From the many inquiries from various parts of the world, we anticipate a very satisfactory business for 1895."

Frank S. DeRonde,
Gen. Sales Agt.
The Standard Paint Co., New York.

"We do not like to appear pessimistic. There is now a large demand for electrical supplies, especially for electric railways, but manufacturers and dealers in almost every thing electric have sprung up like mushrooms and there are several very hungry mouths to feed—open mouths for every morsel offered. So many that it certainly seems that several must starve and many others remain hungry. I think most lines of electrical goods are being sold with very little or no profit and where so large a portion of the contractors are without financial backing, there must be frequent losses. My idea is that the manufacturers of electrical goods, except of patented specialties, who go through the year of 1895 without loss will have reason to be thankful."

Henry A. Reed,
Bishop Gutta Percha Co., New York.

"We are in the habit of regarding our business as a very good index of the general prosperity of the country because a new steam engine means, almost always, the opening up of a new enterprise or the improvement of an old one. . . . . So far as we are able to observe, steam engine builders are all very busy. Our correspondence indicates a fair amount of inquiry and very good prospects for future business. . . . ."

S. F. Bagg,
Secretary.
The Watertown Steam Engine Co., Watertown N. Y.

"There has been, and will, I think, continue to be, a a gradual improvement in the electrical business. This improvement may be slow and hardly perceptible at times, but nevertheless will continue. My opinion is that there will be a large amount of business done in the electrical line notwithstanding general business depression, for the reason that capitalists and corporations will take advantage of the prevailing low prices in which to make an investment in a new plant or the overhauling of an old one. This is undoubtedly a most favorable time for cash buyers, and they will not be slow to take advantage of it."

F. B. Badt,
Siemens & Halske Electric Company, Chicago.

"The demand for electrical apparatus throughout the country is very good. The unsettled financial questions, however, now before Congress makes it difficult to get the necessary capital to carry out projected enterprises. My opinion is that if these questions could be settled we would witness a great improvement in trade, but otherwise we are likely to have a dull trade during the spring."

D. P. Perry, Manager,
Standard Electric Company.

"We think the prospects for business in 1895 are very bright indeed. Not only have inquiries multiplied ten fold but the increase in volume of business done during the last three months we think justifies us in the belief that there is a more solid foundation for calculation than at any time during the last eighteen months. While we do not think the electrical industry has suffered relatively more than others, we feel confident that there is a great future for it.". . . .

The C & C Electric Company,
A. Mitchell Hall, General Manager.

Statement of the Binghamton R. R. Company.

The following comparative statement of the earnings and operating expenses of the Binghamton R. R. Company has just been made:

Office Binghamton R. R. Company,
Binghamton, N. Y., Jan. 1, 1895.

Six months July 1 to January 1, 1893 and 1894:

	1893.	1894.
Receipts	$57,654.32	$70,913.16
Operating Expenses	31,394.20	36,403.48
	$26,260.12	$34,509.68
Taxes	1,400.00	1,551.00
Net Earnings (six months)	$24,860.12	$32,958.68
Operating Percentage of Receipts	54½ %	51¼ %
Gain in Receipts for 1894		$13,258.84
Gain in Net Earnings		8,131.56
Percentage of Gain in Receipts 1894 over 1893		23 %
Percentage of Gain in Net Receipts		32¾ %

LEGAL NOTES.

BERLINER PATENT VOID.

Opinion in the case of United States of America vs. The American Bell Telephone Company, et al, in the Circuit Court of the United States is in abstract as follows:

Carpenter, J.: This is a bill in equity praying the repeal of Letters Patent No. 463,569, issued November 17, 1891, to Emile Berliner, as assignor to the American Bell Telephone Company for Combined Telegraph and Telephone. The first ground of the bill to which I shall refer is that the patent is void as being beyond the power of the Commissioner to issue, in view of the issue of a former patent, No. 233,969, issued November 2, 1880, to Emile Berliner for Electric Telephone.

The patent of 1891 is for a transmitter for a speaking telephone. The fourth claim of the patent of 1889 is as follows:

4. A system of two or more telephone-instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate so that any vibration which is made at one contact is reproduced at the other, substantially as set forth.

This patent is, therefore, for the "system" or combination of a transmitter and receiver for a speaking telephone. The whole apparatus is shown in the drawings of both patents and is identically the same in both. The transmitter and the receiver are identical in form and differ in function according as they are placed at the transmitting or at the receiving end of the telephone wire. It, therefore, appears that one of the functions of the device shown in the patent of 1880, namely the function of transmitting articulate speech, is identical with the sole object or function of the device covered by the patent of 1891 and that the device for effecting the transmission is identical in both patents. The patent, therefore, seems to me to be void and beyond the power of the Commissioner to issue. *Miller v. Eagle Manufacturing Co.*, 151 U. S. 186.

The second ground of the bill is that the issue of the patent was unlawfully delayed through the fault of the respondents. The respondent company were the owners of a patent previously granted to Alexander Graham Bell which covered the art of electrical transmission of articulate speech. The device of Berliner, as both parties in this case agree, covers the only commercially practicable and useful method at present known for effecting such transmission. In this state of facts, the claim of the complainant under this bill is fully and briefly stated by counsel in the following words:

"The proposition is that the Bell Company intentionally delayed the prosecution of the Berliner application and the issue of the Berliner patent for the purpose and with the result of prolonging their control of the art of telephony, which would cease with the expiration of the Bell patent in 1893; and that they did this by submitting to delays on the part of the officers of the Patent Office, which delays they, the Bell Company, had in it their power to prevent, and refrained from preventing, for an unlawful purpose. This conduct is alleged to constitute a fraud practiced upon the public through the Commissioner of Patents and his assistants. And it is claimed that the patent so obtained by such fraud may be and should be annulled by the decree of the court, on the authority of the *United States v. American Bell Telephone Company*, 128 U. S. 315, because there is no substantial difference between fraud practiced upon the Commissioner as an agent of the public, and a fraud practiced upon the public with the Commissioner's connivance or acquiescence."

The application for the patent was filed June 4, 1877, and the patent was issued November 17, 1891. The patent to Bell expired in March, 1893. The device covered by the patent in suit had been in public use by the respondent corporation since the year 1878. The respondent corporation was of ample means to prosecute the application. The result of any delay which might take place in the issue of the Berliner patent would evidently be to continue so much longer the practical monopoly of the art of electrical transmission of articulate speech. Under these circumstances, I think it clear that the duty of the respondent corporation was to use the greatest degree of diligence in prosecuting the application to any early issue. There should have been, at least, as great diligence as their own interests would have called for, had their business been unprotected by patent rights.

Thus far there is no dispute between the parties here. It is admitted that the greatest diligence was incumbent on the respondent corporation, and that if there be unlawful delay and that if there be bad faith and an intention to delay on the part of the applicant, then the patent may be here held to be void.

From the filing of the application up to June 9, 1882, it is not contended that there was any delay upon which a decree here should be founded. There were delays in prosecuting the application, but they are said to be no greater than is usual in the Patent Office. On the date last given the solicitor in charge of the application was notified by the examiner that "as at present advised, it is believed that the claims presented may be allowed, but final action in this case must be suspended in view of probable interferences with other pending applications."

In October 1883, the solicitor wrote to the office asking that the case might receive attention, to which it was replied that the apprehended interferences had not yet been declared; and the correspondence was continued in the same sense until March, 1888, when the application was suspended until May 1, 1888, on the ground of the expected interferences and also "for the purpose of awaiting the determination of the telephone cases in the Supreme Court."

The application with which an interference was anticipated was that filed July 26, 1880, by Daniel Drawbaugh, in which he claimed to be the original and first inventor of the telephone.

It was evident that in no case could Drawbaugh be entitled to a patent. He was clearly barred by the prior use of his invention. On the other hand it is to be observed that the action against the People's Telephone Company might not be finally decided for many years and that when decided it would not necessarily throw any light on the question then pending in the patent office; namely whether Berliner or Drawbaugh was the first inventor of the microphone transmitter. In October 1891 the proceeding came to an end by a final decision of the Commissioner to the effect that Drawbaugh was barred by the prior use of his invention. On the next day the Berliner patent was ordered to issue "largely because well settled principles of public policy forbid us to give any further opportunities for holding this application in the office."

There was no effort, so far as I can see in the evidence, on the part of the respondent corporation to prevent this further delay. There was ample evidence before the Commissioner of the fact of prior use; the applicant, Drawbaugh, declined to take evidence in contradiction; and it seems to me clear that the respondent corporation should have urged upon the Patent Office a decision on the *prima facie* case which they had made.

I am persuaded that the delay thus caused as well as the delay previous to the decision of the Supreme Court was intentionally acquiesced in by the respondent corporation for the purpose of delaying the issue of the patent. This seems to me the only conclusion from a consideration of the whole evidence. It is in proof that during the whole of the time from 1882 to the issue of the patent, and perhaps earlier, the solicitors of the Bell Company were urgently insisting to the officials of the Patent Office that prompt action should be taken in the application. Even while the "general understanding" was in force to the effect that the application should await the decision of the Drawbaugh case in the courts, the evidence shows that these urgent applications were made to the patent office officials. I cannot think that it was by anyone expected that such oral applications should have any effect unless, at least, they were made in support of formal applications made on the record and of formal arguments and representations made in support of such applications. The officers of the company also testify that at all times they were urgent in pressing for the issue of the patent. As to their state of mind and their actual intention at the time I am free to say that I place less reliance on their statements now made than on a single statement made at the time. In February, 1886, while the "general understanding" was in force, Mr. Swan, one of the solicitors for the application, wrote as follows to the president of the Bell company: "I am working the Edison and Berliner cases along quietly and think they will be granted by the examiner without interferences or appeals so that we can take them out by paying the final fees. We have six months to do that in." This is but a single paragraph out of many hundreds of pages; but I think it shows clearly what was the purpose of the respondent corporation, consciously formed by their officers and perfectly understood by their agents at the Patent Office. The application was to be "worked along quietly," although apparently pushed with great energy; there would be delay, but no substantial obstacle to the grant of the patent; and even after the patent should be ordered to issue there might be a further delay within the limits of the law and without imperiling the patent. If this letter does not mean this, I am at a loss to know what it does mean.

My conclusion, therefore, is that the complainant has made out the case and that there should be a decree that the patent in question is void and shall be delivered up to be cancelled.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Montreal, Que.—The Temple Electric Company contemplates the addition of an engine and also the construction of a new and improved central station. Charles Morton is purchasing agent.

Quebec, Que.—The Montmorency Electric Power Company contemplates the installation of three alternating dynamos. Its plant is eight miles from Quebec, and power is taken from Montmorency Falls.

Otsego, Mich.—It is reported that the "City Fathers" are still wrestling with the franchise question. George C. and B. A. Nevins are interested in the outcome.

Lethbridge, N. W. Ter.—The Lethbridge Waterworks and Electric Light Company (Limited), has just added a second incandescent dynamo. M. Freeman is purchasing agent.

Hillsboro, Tex.—The Hillsboro Investment and Electric Company contemplates the construction of an ice plant. E. G. Shields is purchasing agent.

Cowansville, Que.—G. K. Nesbitt, owner of Electric Light Plant, wants a system to run to next town, two miles distant, for about 200 16 c. p. lamps, and to give 12 lamps to the horse power.

Exeter, Ont.—The Exeter Electric Company contemplates the construction of a dam in order to run its plant by water power. J. W. Howard is purchasing agent.

Montreal, Que.—The La Compagnie Electrique St. Jean Baptisto, 396 Montana street, will construct new lines, add two dynamos and another engine in May next. Its capital stock will also be increased to $300,000.

Durand, Wis.—The Durand Electric Company, which is now being organized, expects to do the city lighting when its plant is completed. F. J. Gobar is purchasing agent.

Holland, Mich.—The capacity of the City Electric Light Plant is to be increased by the addition of a 1,200 to 1,500 light alternating dynamo. William J. Trott is superintendent.

Ephrata, Pa.—The Ephrata Electric Light Company will erect its plant next spring and install a first-class equipment, both arc and incandescent. A. M. Baker is purchasing agent.

New London, Wis.—S. A. Sherman, Stevens Point, Wis., will add a 1,500 light dynamo to the equipment of his plant, which is leased to Burdick & Macklin until April 1, 1895.

Harrisburg, Ill.—J. G. Porter will add a 1,000 light alternating dynamo soon.

Sheridan, Wyo.—The Sheridan Electric Company contemplates the addition of an engine, boilers and an alternating dynamo. L. S. Benton is purchasing agent.

Jalapa, Mex.—Yslas & Leal, calle Enriquez No. 117 east, Vera Cruz, Mexico, have a contract to build a plant of 30 arc and 100 incandescent capacity at Coatepec, Mexico. They are now at work on its construction. The plant will be three miles distant from Coatepec.

Addison, N. Y.—F. H. Wheaton is enlarging the capacity of his plant and will add an incandescent equipment.

Franklinville, N. Y.—The Franklinville Electric Light & Power Company may add about 200 incandescent lights. W. H. Ferris is secretary.

Bastrop, Tex.—The Bastrop Water & Light Company has an exclusive franchise for 20 years. C. Erhard is purchasing agent.

Sherman, Tex.—The City Lighting Plant will have its equipment increased by the addition of new boilers and additional street lamps. W. A. Williams is purchasing agent.

Nazareth, Pa.—The Nazareth Electric Light & Power Company will light the borough with 20 arc lights, add a boiler and dynamo, and extend its lines one-half mile. Frank Wunderly is purchasing agent.

Culpeper, Va.—The Electric Light Company reports its plant as not running on account of lack of money, and a purchaser is wanted. It is stated that it would be a fine investment.

McDonald, Pa.—The Citizens' Electric Light, Heat & Power Company will double its present capacity.

Montrose, Pa.—The city will erect and equip an electric light plant, and it is hoped that it will be ready for operation by February next. F. I. Lott is chairman of committee.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

East Palestine, Ohio.—Franchise for an electric light plant has been granted to Geo. E. Seabring.

Owensboro, Ky.—An electric light plant will be installed for which bids are asked by W. P. Small.

Mercer, Cal.—An electric line is projected from Mercer to the Yosemite Valley. Chicago capitalists are interested.

Winton Place, Ohio.—A franchise has been granted to the Cincinnati Street Railway Co., for a railway through this village.

Henderson, Ky.—City contemplates putting in an electric lighting plant. A. B. Hart is chairman of the electric light committee.

St. Louis, Mo.—The Florrisant Avenue Electric Railway Company has recently been incorporated to build and operate electric railways.

Bowling Green, Ky.—An electric railway has been projected here, and bids on work and equipment will be received by the engineer, M. H. Crump.

Mackinac Island, Mich.—A franchise has be granted for an electric railway around the Island. Mr. J. H. Roberts of Grand Rapids secured the franchise.

Waukesha, Wis.—The Waukesha Beach Electric Railway Company hopes to have its line ready for operation by June, 1895. T. E. Ryan is secretary.

Norfolk, Va.—The Port Norfolk Electric Railway Company contemplates an immediate change from horse to electric power. Will exchange 6 per cent first mortgage bonds for its equipment. M. W. Mason is general manager.

Atchison, Kan.—The Atchison Railway, Electric Light & Power Company will add four miles of track and six motor cars about April 1, 1895. J. A. Bendure is purchasing agent.

The January Review of Reviews, in its "Progress of the World" (editorial) department, discusses present problems in public health administration, municipal reform in the United States, the movement for deep waterways from the great lakes to the Atlantic Ocean, the Nicaragua Canal question, the proposed arbitration of the boundry dispute between Venezuela and Great Britain, the payment by our government of damages to Canadian seal poachers, the prospects of civil service reform, the demand for a bank-note currency, the change in the Canadian premiership, the disposition of English visitors to instruct Americans, and the recent action of the American Federation of Labor; among foreign topics receiving treatment in this department are the Armenian question, the war in China, the approaching parliamentary contest in Great Britain, the London School Board election, South African affairs, the French in Madagascar, and the death of the Princess Bismarck.

FINANCIAL.

The near approach of the end of the year and the holiday season caused a diminution in the volume of trade for the month. The construction work under way and the winter weather has maintained the demand for supplies. The supply houses can, however, well utilize any slack in business at this time in clearing up and preparing for inventory the first of the year. A light demand for material was the rule for the month, stock of all kinds being allowed to run low until after the holiday season. A good demand is looked for the first of the year, and better prices will undoubtedly prevail.

The stock market has been unusually quiet. But few buyers of electrical stocks were out. The most noticeable movement during the month was the drop in Bell Telephone from 201 to 191, resulting from the adverse decision in the Berliner patent case, the government having won the suit for the cancilation of the patent. The case will undoubtedly be appealed, but the company can hardly expect a reversal of the decision. The General Electric stock has fluctuated a considerable, having fallen during the month to 33¼, but has since recovered and now stands about 35. There has been nothing worthy of comment concerning other stocks.

The end of the year comes as a relief to many, having been a year of hardships, yielding little or no returns. The first of January promises a more profitable season and although it may not be realized, yet encouragement is given to the efforts for a successful year. The experiences and lessons of the past two years will not soon be forgotten and will be profitably remembered. While business has improved toward the close of the past year, prices have remained at an unprofitable point. A slight improvement in this respect is expected.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Dec. 26.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	191⅛
“ “ “	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	90
Commercial Cable Co	Com.	7,716,000	100	....	....	125
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	F. Q.	126
“ “ “ ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C.Bds. 1901.	586,500	100	6	M. & N.	......
“ “ Brooklyn..	Com.	2,500,000	100	....	Q. F.	109
“ “ “ ..	1st. 1940.	500,000	100	5	A. & O.	100
“ “ “ ..	Regis.	....	100	5	A. & O.	......
“ “ Chicago...	Com.	3,000,000	....	8	Q. F.	135
“ “ “		2,500,000	....	....	....	......
“ “ New York.	Com.	7,938,000	100	....	Q. F.	101
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	107
“ “ Phila......	Com.	1,473,000	100	....	....	122
“ “ “		....	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	3
General Electric Company.	Com.	30,457,000	100	....	......	35½
“ “	Prf'd.	4,251,900	100	....	....	67
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	88
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	103
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	90
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	......
Thomson European Welding Co.	Com.	1,500,000	100	...	....	......
Thomson-Houston Elec. Co . .	Series D.	120,000	10	....	....	5⅜
Thom'-n-Houst'n Intern.Elec.Co.	Com.	600,000	100	...	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	......
United Electric Securit'es Co....	Com.	1,000,000	100	....	....	......
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q. J.	86½
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	34
“ “ “	1st Pf.Cum.	3,755,700	50	7	....	51
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R...............	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
“ “ “ ..	1st Bds.1909	300,000	100	5	J. & J.	90
“ “ “ ..	Certf. 1894.	300,000	100	6	J. & J.	100
BUFFALO—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	57⅛
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	100
BOSTON—						
West End St. Railway...........	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,400,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100⅛
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	33
“ “	Prf'd.	1,000,000	100	5	A. & O.	85
“ “	1st Bds.1930	6,000,000	100	....	J. & J.	......
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	93⅛
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	155
“ “	Bds.	2,000,000	100	....	....	98
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	...	....	26½
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	103
. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	20
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	102
ittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		37
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	12½
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company.. .	Com.	5,000,000	100	...	....	67
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	99
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban............	Com.	2,500,000	400	....	....	17
“ “	Bds. 1921.	1,400,000	100	6	F. & A.	105
Union Depot Railway............	Com.	1,200,000	100	....	....	100
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	105

TRADE PUBLICATIONS.

The Buckeye Electric Company of Cleveland, O., has remembered its many friends and customers by a very neat calendar, in the design of which the incandescent electric light is prominently shown in the foreground leading all other forms of illumination.

The compliments of the season have been extended to the trade through the medium of a calendar printed on heavy board by the Ziegler Electric Company of Boston, Mass. The calendar is printed on the center of the hanger, and around it are shown some of the great varieties of electrical and scientific goods manufactured and sold by this house.

A very appropriately designed calendar has been sent out to the trade by Alfred F. Moore, manufacturer of insulated electric wires and cables, of 200 N. Third St., Philadelphia. This house was established in 1820, and when the demand for insulated electric conductors became manifest, that department was added to the already large establishment. The line now manufactured includes all the standard styles. The pages of the calendar are large and clear, displaying the usual information regarding the days of the month, year, etc.

The American Electrical Works of Providence, R. I., has distributed among its many friends and acquaintances a unique token carrying New Year's greetings. It is novel and ingeniously gotten up. This house, as the holidays come, has always some appropriate device which carries with it the compliments of the day or season. So novel and interesting have these been that the fraternity looks forward to their appearance with some curiosity as to what new manner this enterprising house shall extend its greeting. Such pleasant remembrances cut off the sharp edges of business methods and establish pleasant and lasting relations.

An illustrated and descriptive catalogue of efficient power pumps for every variety of service has recently been issued by the Goulds Manufacturing Co., of Seneca Falls, N. Y. It is the fourth catalogue published in this series, and it has been the endeavor of the company to make it the most complete catalogue of power pumps. A specialty is made of triplex pumps and prominence is given to them in this catalogue. Several designs of this type and of others are shown which are for the first time presented to the public. This company is one of the oldest manufacturers of pumps and the experience gained has led to many improvements in pumping machinery. The catalogue also contains considerable information regarding pumping machinery, the different types of pumps, the rates of suction and discharge illustrated by diagrams, the manufacture of pumps, etc. A number of pumping plants are illustrated and described using different forms of power. Electric power receives special attention. The cuts showing the different styles of pumps are very clear and the descriptions exceedingly comprehensive. The catalogue forms a volume of one hundred pages, well bound, with neatly designed covers.

Heavy duty steam engines and boilers are illustrated and described in a very fine catalogue issued by the Atlas Engine Company of Indianapolis, Ind. Its pages are large, the paper of an excellent quality of heavy book; the cuts have been well executed and the skillful make-up has produced a fine catalogue throughout. The Atlas heavy duty and automatic engines are clearly illustrated and described. The Atlas tubular boilers are shown by numerous cuts displaying the different designs of fronts and arrangement of parts. There is also shown the method of setting the boilers, several pages being taken up with cuts showing clearly their erection. Dimensions are given and all the necessary information for doing the work. Two colors of ink are used very ingeniously and in such a way as to give prominence to important facts concerning these engines and boilers. The engines comprise several types, as different classes of service demand, and each shows a substantial form indicating strength and durability. The automatic heavy duty engines are especially worthy of the attention of engine users. The different parts and construction are described and illustrated by cuts. The simplicity of the design, the strength of every part in proportion to the work it has to do, the character of the metal used, the construction of the main bearings, valves, etc., are points especially referred to. Some information regarding engine foundations is also given, accompanied by the plans for the Atlas engine. The catalogue contains much interesting matter especially valuable to engine users.

The Manhattan Electrical Supply Company of 32 Cortlandt street, New York, has just issued the second edition of its descriptive pamphlet on electric telephones and supplies. It contains a plain statement of the telephone situation, the power of the magneto telephone and other forms of transmitters. The line of telephones and accessories listed includes a great variety, adapted for a wide range of service. Simple outfits for short private lines, as well as the more expensive telephone equipments, are shown. Considerable information is given regarding the selection and purchase of telephones and their installation. Telephone exchange equipments are also furnished by this house. The telephones are mounted in a number of styles in accordance with the kind of instrument and the service for which they are intended. Many ingenious devices are employed for making such connections as are required. Magneto bells are made in several styles for double or single call service. Among the supplies listed are line material, call and alarm bells of different kinds, fan motors and outfits, dry batteries, etc.

A supplement to the large general catalogue of the Central Electric Company has just been issued. Although it is a supplement it makes a catalogue of considerable size. The pages are the same size as in the general catalogue and are made up in a uniform style. The method of classification is the same and each department is a supplement to the department in the general catalogue. The more recently designed apparatus and electrical supplies are listed which have been placed on the market during the past few months. Under the supplement to Lundell motors appears a description of Lundell direct current motors and generators and a cut of the special compound wound generator. The latest information regarding these goods is given together with a number of new applications. Supplement to fan motors shows many improvements and new designs. Under the department of construction material the iron armoured interior conduit occupies a considerable space. This conduit has but comparitively recently been placed on the market and the conduit, the fittings and tools used in its installation are new. The many fittings are illustrated individually and the method of installation shown in a number of views. In this department are also listed many insulators, etc., and the B. & S. insulating compounds and preservative material. Many new tools are listed for electrical workmen, among which might be mentioned Wilson's combination soldering torch, Henderson's link belt boring machine, etc. The department of incandescent lamp supplies contains a very extensive list of new devices and material. Additional information is given regarding many of the standard supplies and it should therefore be in the possession of all those who have the large general catalogue. Station supplies have been supplemented by many new appliances, new styles of rheostats, the Sweet limit switch, starting switches, etc., being among those here listed. Heating and cooking electrical apparatus has received the addition of a number of new appliance. Sad irons, hot irons and various cooking utensils are here listed. Each piece of apparatus has a trade word to facilitate the transaction of business and the supplement is indexed in the same manner as the general catalogue which is most complete in this respect. This supplement is but another evidence of the progressiveness of this well-known house and it will be appreciated by users of electrical goods. The value of catalogues in the distribution of electrical supplies is fully appreciated by this company and its general catalogue is a most complete reference book for the trade.

The new year's greeting of S. F. B. Morse & Co., could not but be well received by their numerous friends and acquaintances. Du Viviers "Old Coronet" and the fragrant Havana helped to recall the pleasant features of the relations of the past year and promise similar ones for the new year. It is a bright idea for such an occasion and offers as one of the good things for 1895 a liberal use of Kerite wire and cables of which the New Year's greeting is a happy reminder. A similar greeting was sent out by their predecessors, Cushing & Morse, which attracted much attention. The new firm has done well in repeating the "happy thought." ELECTRICAL INDUSTRIES, with their many other friends, wishes the firm a happy and prosperous new year.

NEW BOOKS.

A Scientific French Reader. Edited with Introduction, Notes and Vocabulary by Alexander W. Herdler. 12mo, pp. 196. Boston: D. C. Heath & Co. 85 cents.

The author has intended in this volume to give the student a general familiarity with French technical terms and style. Especial attention is given to those connected with electricity and mechanics. Physics, chemistry, etc., receive proper consideration. Special care has been given to the vocabulary.

Poor's Directory of Railway Officials and Manual of American Street Railways. Ninth annual number, 1894. New York: H. V. & H. W. Poor, 44 Broad street; 450 pages, cloth.

This volume contains lists of the officials of all railroads in North America and of the leading organizations auxiliary to the railway systems; also lists of officers of South American and Hawaiian railways, etc. The directory contains much additional data, making it still more complete than previous volumes. It contains not only a list of the officials of the corporations, but also of the master mechanics, chief engineers, master car builders, general managers and superintendents. It is a most valuable reference book on these subjects, and is an important supplement to Poor's Directory of Railroads. The volume is bound in the same general style as the latter, which is neat and substantial.

PERSONAL.

Mr. J. W. Godfrey recently resigned his position as general manager of the New York Insulated Wire Company and has accepted the position of manager of the sales department for Habirshaw, wire and cables.

Mr. E. M. Engelman, of the Cummings & Engelman Conduit Co., Detroit, was a Chicago visitor recently. Mr. Engelman reports excellent prospects for the new year and plenty of business on hand.

Mr. J. J. Gates has accepted the position of general manager of the Perkins Electric Switch Mfg. Co., of Hartford, Conn. Mr. Gates has a wide acquaintance in the electrical field through his former connection with the Perkins Electric Lamp Co., and Waring Electric Company. The new general manager will be a valuable addition to the staff of officers.

BUSINESS NOTES.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, is extremely busy in filling its orders. Among other exchanges starting January 1 is that of Fostoria, O., 200 lines switchboard capacity and 130 telephones; also Van Wert, O., 100 lines switchboard capacity and 65 telephones.

R. THOMAS & SONS have removed their western office from 142 Lake St., Chicago, to 1532 Monadnock Block, where it is under the management of Grier Brothers who also represent in the west the Bryant Electric Company. A large stock is carried in warerooms in Chicago so that prompt shipments are always assured.

LAING MACHINE CO., North Kankakee, Ill., has added an electrical department to its works. In this department will be constructed electrical machinery, especially electric street car trucks, motors and generators. This department is under the supervision of Mr. Henry Cordels who is given a high reputation as an electrical and mechanical engineer.

THE WASHINGTON ELECTRIC COMPANY, Chicago, finds itself very busy in filling orders for stage dimmers, telephone switch boards, annunciators, arc lamps, etc., its leading specialties. Most excellent progress has been made by this company and its business is very satisfactory. During the month of December alone the company delivered 20 stage dimmers, aggregating over 1,500 lights.

THE GENERAL ELECTRIC COMPANY has found it necessary to increase its buildings at Schenectady by the addition of a store house 353 feet long by 52 feet wide and a laboratory for standardizing. The foundations are already laid and the superstructure will soon be completed. The store house will relieve the smaller storehouses now inadequate to accommodate the material and completed or partly completed goods. The laboratory has been found a necessity on account of the heavy currents used about the works. The standard instruments will be kept in this building and the instruments used in the works will be compared with them.

The Standard Underground Cable Company, although meeting with an irreparable loss through the death of its former Chicago manager, Mr. F. E. Degenhardt, will maintain its Chicago office in the Rookery Building. Mr. F. S. Vieie, who has been connected with the company for a number of months, will have charge of the office for the present and look after all the business connected therewith.

India Rubber & Gutta Percha Insulating Company, New York, the well-known manufacturers of Habirshaw white-core insulated wire and cables, has placed its sales department under the management of Mr. J. W. Godfrey, who has associated with him Messrs. F. W. Harrington and J. B. Olsen. These gentlemen are well versed in the wire trade, having for years been engaged in its sale. With this strong force Habirshaw wire will undoubtedly have a successful year.

Empire China Works, 144-156 Green St., Brooklyn, N. Y., the well-known manufactory of hard porcelain insulators of every description, is now making a specialty of porcelain for electric street railway use. This company has furnished everything of this kind used by the Brooklyn City Railway Company of Brooklyn, N. Y. The facilities of the company and the goods now produced are such that the wants of street railway companies are fully met. The insulating qualities of porcelain are so fully established that they are given the preference.

The Standard Electric Company, Chicago, reports a most encouraging outlook for business. Among other contracts the company has just closed, in the face of the bitterest competition, one of the most important contracts of the year. This contract is with the Capitol Electric Company, of Springfield, Ill., for five 80-light arc machines and 400 arc lamps, together with a 1,500-light alternator. The company will also do all the line construction. Since November 1st the Standard company has made and shipped over 1,500 arc lamps.

Cummings & Engelman Conduit Co. Detroit, Mich., has recently been reorganized and is now prepared to furnish complete conduit systems for bare copper conductors for street railway feeders and electric light circuits. The conduit systems installed by this company are in use in Chicago with conductors carrying current at 2,000 volts,at St. Paul and Detroit. The conduit is simple in construction, easy to install and durable in service. Its construction was illustrated and described about a year ago in this journal. A new catalogue just issued gives descriptions of the systems, etc.

The Stanley Electric Manufacturing Co., Pittsfield, Mass., through its western representatives, Messrs Hine and Wallace, Chicago,reports a very satisfactory business throughout the west in the introduction of its two-phase apparatus. Quite a large number of plants are now in operation in the west and giving entire satisfaction. The outlook for business for 1895 is reported very bright. The company's facilities are taxed to their utmost capacity to fill orders for machines sold ahead, the factory running day and night. The sales of the company's wellknown transformers show a very considerable increase over former records.

J. Holt Gates, 1140 Monadnock Block, Chicago, reports electrical business brisk. He has just secured the services of Mr. G. W. Atterbury, formerly of the Westinghouse and General Electric companies, and Mr. John L. Martin, formerly manager of the western central station department of the General Electric Co. Owing to the increase in business more room was found necessary and another office has been added. Among other sales he reports the complete equipment of the Elkhart & Goshen (Ind.) Interurban Road with Mansfield Card railway motors and Mather generators. A machine a day is the record with "Gates of Chicago."

The Chicago Insulated Wire Company, Chicago, reports a very satisfactory business at the present time. Mr. T. C. Turley, the manager of the company, hopes for a more prosperous year during 1895. During the past year the company has had a very satisfactory amount of business in spite of the unusual times, and has put on the market a number of new brands of wire, among which are the following: weather-proof cable, silk covered magnet wire, annunciator cables, fixture wire, and tie wire. The facilities of the company have been increased so that it will be able to supply customers without delay with whatever goods they may desire.

The Electric Appliance Company, 242 Madison St., Chicago, is offering something new in the line of an alternating current switchboard instrument, made by the Whitney company. The instrument is of a special form, with a large scale particularly adapted for switchboard work. The frame and case are entirely of metal, and all connections are made at the back of the board. The instrument does not require recalibration and is not affected by external magnetism, and promises to be a "winner." The Appliance company reports the demand for supplies and wire as good. Paranite and O. K. weatherproof wires are generally recognized as leaders and are giving satisfactory service in thousands of installations.

S. F. B. Morse & Co., 225 Dearborn St., Chicago, succeed on January 1, the well known firm of Cushing & Morse, general western agents for Kerite insulated wires and cables. The former partnership is dissolved, Mr. Cushing retiring and the new firm succeeds to the business and good will. It will collect all accounts and settle all claims against the old firm. Mr. Cushing and Mr. Morse have each been long and favorably known to the trade and each will carry with him the good wishes of a large circle of friends and acquaintances. The new firm will carry a large stock of solid and stranded, plain and braided wire which is guaranteed for "excellence of material and workmanship, high insulation and durability under the most exacting conditions."

The Mianus Electric Co., Mianus, Conn., is manufacturing a quite extensive line of telephones and recently issued an illustrated catalogue showing the styles of telephones and appliances manufactured. The supplies listed include everything for a complete telephone line, wires, pins, brackets, etc., as well as the interior appliances. There is listed in the pamphlet a number of experimental devices and apparatus.

The F. E. Belden Mica Mining Company shows in its annual statement a very successful year's business, although much less than it would have been had the business situation been different. The company pays regular monthly dividends on its capital stock of $500,000; the total dividends paid up to date amount to $121,113. Its products are largely used by the electrical companies for insulation, and the yearly contracts for this purpose amount to a large sum.

The Okonite Co , L't'd, held its annual meeting at its New York office, 13 Park Row, on December 27th. Mr. Edward Lyman Short presided. A large percentage of the stock was represented. The reports from the heads of the departments showed a good business for the year 1894 and substantial indications that the business of the new year just entered upon is to be still better The auditors were re-elected after which the meeting was adjourned. The products of this company are better known and are more widely used each year.

J. H. McEwen Manufacturing Company, Ridgway, Pa., reports among recent sales the following: Two 150-horse-power, simple, direct connected to General Electric generator, Continental Hotel, Philadelphia; one 350-horse-power, simple, direct connected to Walker generator, Akron Street Railway Company; two 60-horse-power, tandem compounds, direct connected to C. & C. generator, Dundee Rapid Transit Company, Elgin, Ill.; one 50-horse-power, simple, to Parmele Eccleston Lumber Company, Jacksonville, N. C.; two 130-horse-power, tandem compound, to R. Dunsmuir & Company, San Francisco, Cal. and two 300-horse-power, to Granite Steel Company, East St. Louis, Mo.

The Perkins Electric Switch Mfg. Co., Hartford, Conn.,has moved into its new factory at 83 Woodbine St., where it has ample room for its extensive interests. The former accommodations had been entirely outgrown by the rapidly increasing business. The new factory is three stories in height and 150 by 40 feet with an L 35 feet by 50 feet. This building gives the company about 25,000 square feet of available floor space. The building is admirably adapted for the business of the company, being well lighted throughout and provided with every facility for conducting the manufacture of the well-known products. There is also connected with the factory considerable vacant ground upon which it is intended soon to erect additional buildings. The company may well feel proud of the new quarters. The moving has required a considerable time and it has been a difficult matter to keep up with orders. With the new facilities it is expected that the company will be able to get up with present orders and get some stock ahead. The demand is constantly increasing for this popular line of goods.

The Watertown Engine Company, Watertown, N. Y., reports among recent sales of its well-known engines the following: Standard Ladder Company, Glenville, O., a 10 by 14 Excelsior automatic engine; to the Rowell & Chase Machinery Co., Kansas City, Mo , 10 by 14 Excelsior automatic; Lord & Burnham Co., Irington, N. Y., 9 by 12 Excelsior automatic; E. P. Hampson & Co., N. Y., 11 by 14 Excelsior automatic, with boiler; S. L. Holt & Co., Everett, Mass., an 8 by 12, Lehigh Valley Railroad Company, 7 by 10, and Home Insurance Co., Minneapolis, Minn., 12 by 14 Excelsior automatics; Williams & Werner, Rochester, N. Y., a 12 by 20 slow speed automatic with boilers; Hendrie & Bolthoff, Denver, Col., a 12 by 20; Keystone Lime and Sand Co., Tyrone, Pa., a 12 by 20, Stevens & Thompson, N. Hoosick, N. Y., two 12 by 20, with boilers; Chadwick Leather Co , Chadwicks, N. Y., a 12 by 20 with boilers, and Piercefield P. &. M. Co., Piercefield, N. Y., two 16 by 28 slow speed automatic engines with six boilers. To the Missouri Medical College, St. Louis, Mo., an 8 by 10 high speed automatic; Vienna Electric Light Co., Vienna, Ill., a 9½ by 10 high speed automatic and boiler; New York Air Brake Co., Watertown, N. Y., a 9 by 10, Manuel Escova, Mexico, an 8 by 10 and a 12 by 14, Nelson Hotel Co., St. Louis, Mo., a 12 by 14, and Merle & Heaney, Chicago, Ill., a 12 by 14 high speed automatic engine with boiler. To the Seville Apartment House, New York, a 10 by 10, B. Goldsmith, Milwaukee, Wis., a 9½ by 10 and 13 by 14 direct connected engine. To the Grand Haven Electric Co., Grand Haven, Mich., a 9 and 16 by 14 compound condensing and to the Cortland and Homer Traction Company, four 11 and 20 by 14 compound condensing engines with boilers.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

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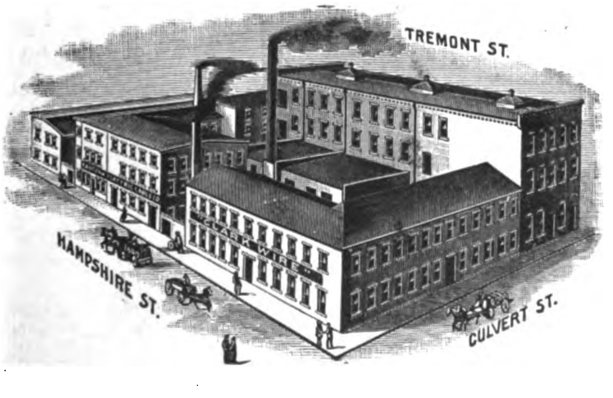
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Electrical Industries Quarterly Directory

CONTAINS COMPLETE DIRECTORIES OF THE

Electric Light Central Stations Electric Railways, Etc.,

..... IN .....

NORTH AMERICA.

PUBLISHED EVERY THREE MONTHS, REVISED TO DATE OF ISSUE; APRIL, JULY, OCTOBER, JANUARY.

JANUARY EDITION READY FOR DELIVERY JAN. 15.

This directory comprises all the Directories of Electric Light Central Stations and Electric Railways which have heretofore appeared monthly in ELECTRICAL INDUSTRIES. To it will be added a complete and reliable directory of Isolated Lighting Plants which is now in preparation and will be ready soon.

It gives the name and location of all the electric light and railway companies.

It contains the names of the officials including the purchasing agent.

It gives the capital stock.

It gives the size of plant.

It gives the name of system of the lighting and railway plants.

It gives the horse power and make of engines or turbines.

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ELECTRICAL INDUSTRIES PUBLISHING CO., Monadnock Block, CHICAGO.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. February, 1895. NEW YORK. No. 2.

The Model Arc Lighting Plant Recently Installed by the Mutual Electric Light and Power Company of Chicago.

It has been said that in the design of a machine we may trace its history. While this may draw somewhat on the imagination, still there is a considerable truth in the statement. A machine as originally constructed possesses such proportions as in the judgment of the designer afford the necesary qualities for the work to be done. Further knowledge and experience causes changes to be made and often these become so radical as to involve an almost entire transformation or, perhaps, the old design may be entirely abandoned for a new one. Thus as year succeeds year the original machine has been changed; one portion has been strengthened, given a different form or a superabundance of material has been removed. The machine as it stands today, although in the light of present practice it is a perfect machine, yet it represents but a stage in its history. A period is reached in the life of all machines when they make history slowly. The design of the machine has reached such a point that its every detail fills acceptably its duty, and further changes seem not to be demanded.

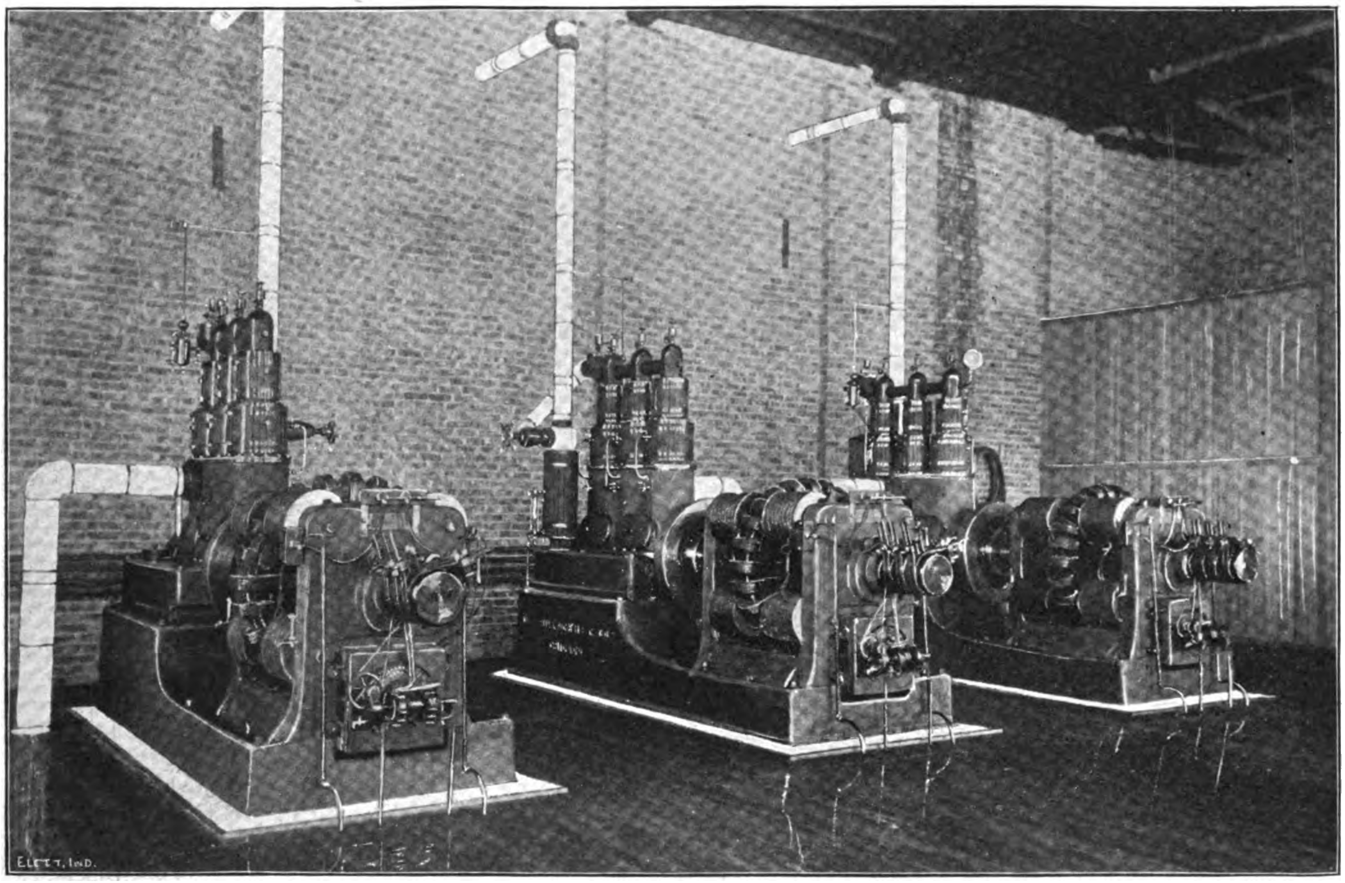


FIG. 1.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY.

Since the introduction of electricity to commercial uses the machines for its generation have been rapidly developed. Their history as traced in the designs shows an unprecedented growth. A comparison of two machines, one of the earliest and one of the latest in use, makes it plain that in a few years a wonderful change has been made. Thus from the old jumbo type of incandescent generator we have the modern type which shows a wonderful saving of material, a neat and compact form which requires comparatively but a small amount of space and which in all respects fills more acceptably the requirements of such a machine. With the dynamo all other parts of the power equipment of the generating station have been developed with a view to reaching the highest point of economy and efficiency. There has also been another most important point sought, a compact form requiring a small amount of floor space, which is especially desirable when large central stations are located where real estate is valuable or where space for other reasons must be economized.

In the design of the electric generating machines, and also in the design of the station itself of the Mutual Electric Light & Power Company, at Chicago, that point seems to have been reached, as above mentioned, when its every detail seems to fulfill so acceptably its duty that further changes seem not to be demanded. The design also marks a departure in arc lighting stations and in the generation of current for arc lamps. As shown in the engraving, Fig 1, the generators are direct connected to the engines and this station has the credit of being the first of the kind in operation.

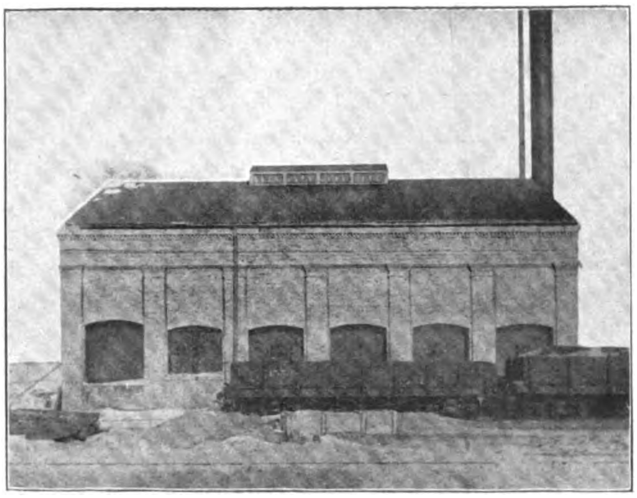


FIG. 2.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY.

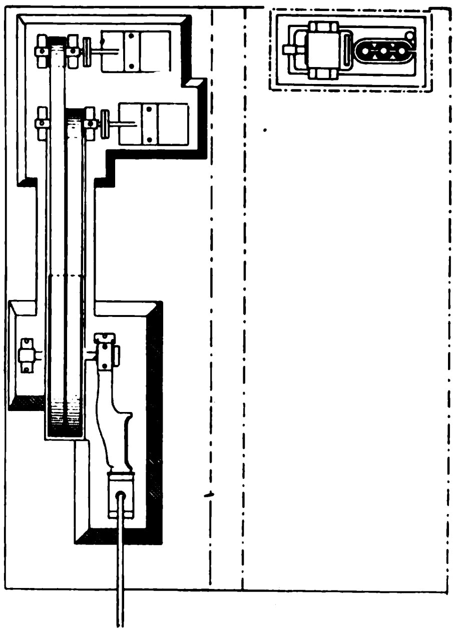


FIG. 3.—A COMPARISON OF TWO PLANTS.

The first arc dynamos constructed were operated at over a thousand revolutions per minute. At that time the maximum speed of the engines suitable for operating dynamos was two hundred and fifty revolutions per minute. The capacity of dynamos has gradually increased and the speed has decreased since that time. The engine builder has constructed his engine for higher speed, and in other ways modified it to meet the requirements for the operation of dynamo electric machines. It was at first necessary to use belts, counter-shafts, etc., and it was a long way from the engine to the dynamo. While in reality they were not over twenty feet apart, it took fifteen years to bring them together. In this plant the belts, shafting, etc., have been discarded and the simplest combination has taken the place of the old cumbersome plant. The Brush Electric Company has produced an arc dynamo of 125, two thousand candle power lights, running at a speed of 500 revolutions per minute, and the M. C. Bullock Manufacturing Company has produced an engine of like speed, well adapted for the work. These two machines are mounted on one bed plate, four feet two inches by ten feet three inches, and are connected by means of an insulated brotherhood coupling. The arrangement forms the most compact combination for the production of current for arc lighting from steam so far designed. The Willans engine, which is of the three cylinder central valve type, is guaranteed an efficiency of twenty-one pounds of water per horse power per hour, and it is expected that even better results will be shown when the final tests are made.

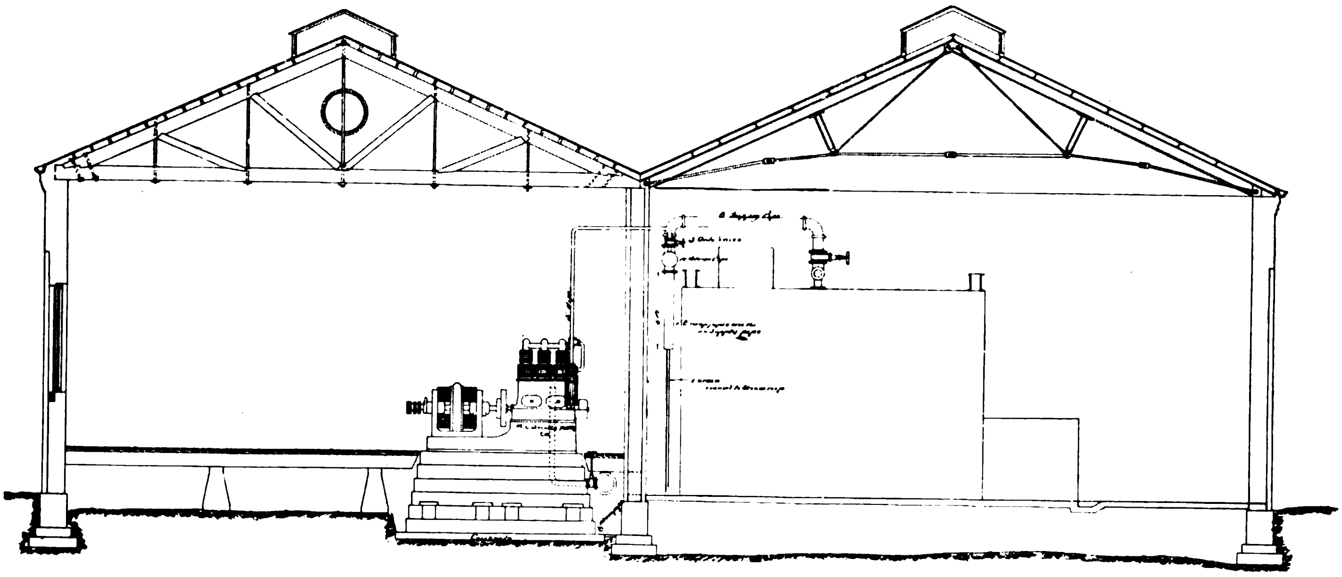


FIG. 4.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY—ELEVATION OF STATION.

The generating plant consists of three of these combinations as shown in Fig. 1. The first one was started on the evening of December 17, 1894. Fifteen minutes after the engine was started the entire load of 125 lights was thrown on, and was run so loaded for the balance of the evening. The dynamo is equipped with an automatic regulator shown on the end of the machine by which the output is regulated as a portion of the lights are turned on or off. So closely is the regulation automatically effected that any number of lights may be thrown on or off at will and the brushes are shifted, while at the same time the current is shunted through the fields. The engine also responds to any change in its load and easily takes care of its end of the business. The two form a combination which automatically regulates itself to any changes in load. This plant has been erected by the Mutual company to light the district bounded by State St., on the east, 39th St., on the north, and the city limits on the south and west. It covers forty-six square miles and contains a population of nearly three hundred thousand people. To those who are familiar with the topography of Chicago, the claims of this portion of the city for future prominence as a residence section will be understood. The plant is located at the corner of 89th and Loomis Sts., on the line of C. R. I. & P. railroad near Brainerd station. The company secured a franchise less than a year ago, and has met many obstacles in accomplishing the work already done. The building is a substantial brick structure ninety by one hundred and ten feet. It is constructed of brick and terra cotta, with an iron roof.

Everything has been planned with a view to durability and convenience. A siding runs along next to the boiler room, and coal is unloaded directly from the cars into the boiler room. The foundations have all been laid deep and in the best manner possible. The engine room floor is of polished wood, through which the foundations rise a short distance. The dynamo room is approximately forty by sixty feet, and contains at the present time three of the 125 two thousand candle power light units, or a total capacity of 375 lights. As will be noticed from the photograph, but a small portion of the floor space of the room is now occupied and it will accommodate with ample space for engineer and attendant to move around the machine, a capacity of 2,400 two thousand candle power lamps or 1 two thousand candle power arc light to every square foot of floor space. For comparison between this combination and other types of engines and belt driven dynamos, Fig. 3 affords an illustration of the relative amount of floor space used. The plants compared are a Corliss engine driving two generators and a Willans engine driving a single generator of equal capacity. To each square foot occupied by the Willans engine and dynamo, eight square feet are required by the Corliss engine and dynamos.

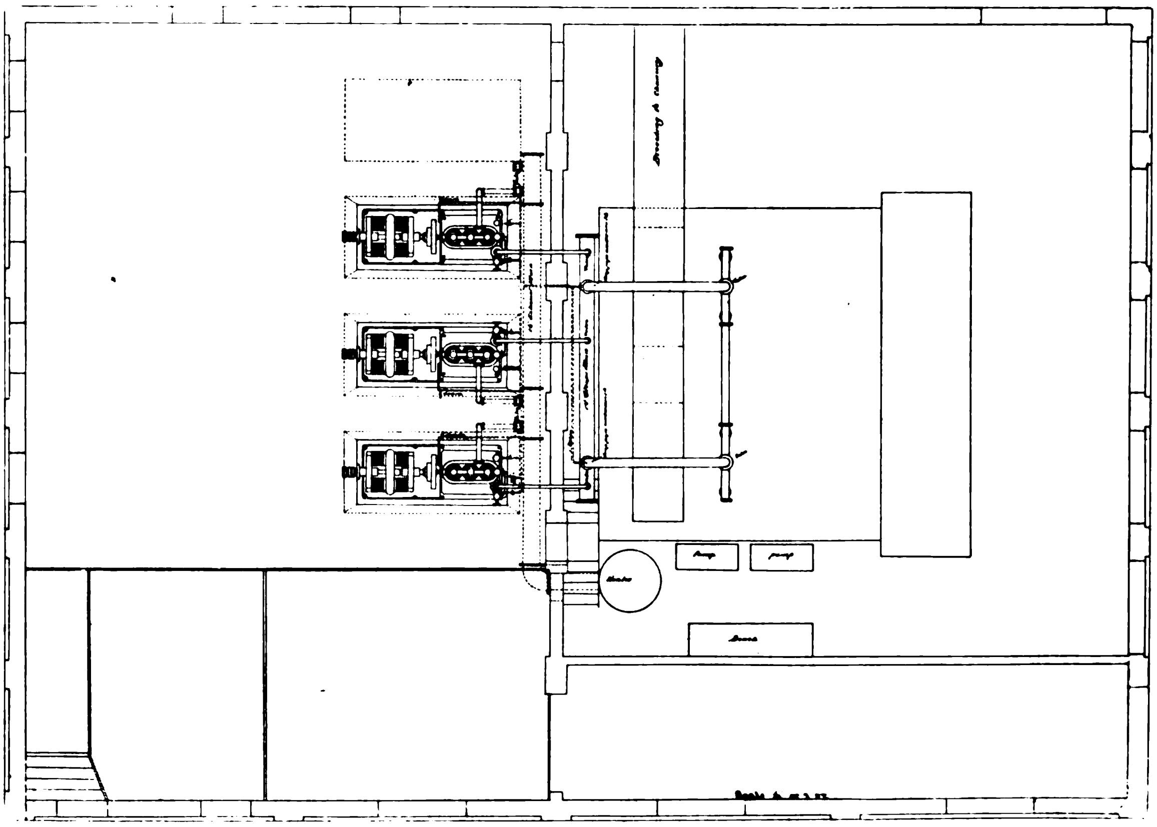


FIG. 5.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY—FLOOR PLAN OF STATION.

The switchboard is of the usual type of the modern Brush board of five panels, and contain besides measuring instruments, ground detector, etc., the necessary spring jacks and plugs for changing or connecting in the dynamo circuits. The feeder wires from the dynamo brushes run down through the floor in iron armored conduit and under the floor to the switchboard. Every wire is in this manner double insulated and protected. Each circuit is protected by lightning arresters, placed on the wall at some distance above the switchboard. The dynamos are the eight pole type of the well-known Brush make. All parts are most carefully insulated for the high pressure currents which are generated. The machines are also nicely finished and the modifications made in the machine for the direct connection give the combination a neat and symmetrical appearance. The electric portion of the equipment was installed by Mr. J. B. McKeown who is one of the Brush company's best experts.

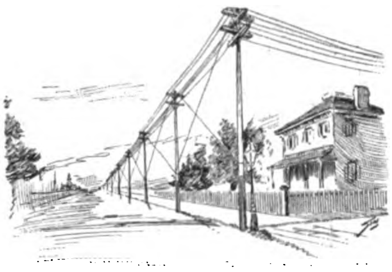


FIG. 6.—A HEAD-GUYED LINE.

One of the noticeable things as one enters the dynamo and engine room is the clean appearance of everything. This fact attracts the attention especially of those who have been accustomed to plants where a large amount of belting is used. Close observers of such plants believe that the rapidly running belts cause a fine oily dust to be diffused in the atmosphere of the room which settles upon all exposed objects. It gives everything a dingy appearance, increases the difficulty of keeping apparatus clean, and often interferes with the testing and repair of such lines as may lie within the station. As a fire hazard it is worthy of investigation, and in the modern station should be considered when classifying risks.

Seventeen miles of pole lines have been constructed and one hundred and thirty lamps are burning and more are being added as the lines are completed. This part of the work has been under Mr. Thurlby's personal supervision and a number of new methods have been pursued. The poles are unusually large and straight and the cross arms are well braced. In order to guard against many of the difficulties which occur on pole lines, Mr. Thurlby adopted what is known as head guying. During extreme conditions of weather unusual strain has caused poles to snap off and portions of the pole hanging on the lines soon destroy a considerable section. These poles being forty and fifty feet in length and seven inches in diameter at the top will stand considerable strain. The method, however, of strengthening the line was by fastening a No. 4 iron wire to the top of one pole and run it to the next pole, 135 feet distant, and tie about twelve feet from the ground. This method is illustrated in the cut, Fig. 6. It was followed throughout the entire length of the line. The strain is equalized, and the copper wires will not be injured by the straining of the poles. After severe ice and wind storms this inexpensive method cannot fail to be appreciated.

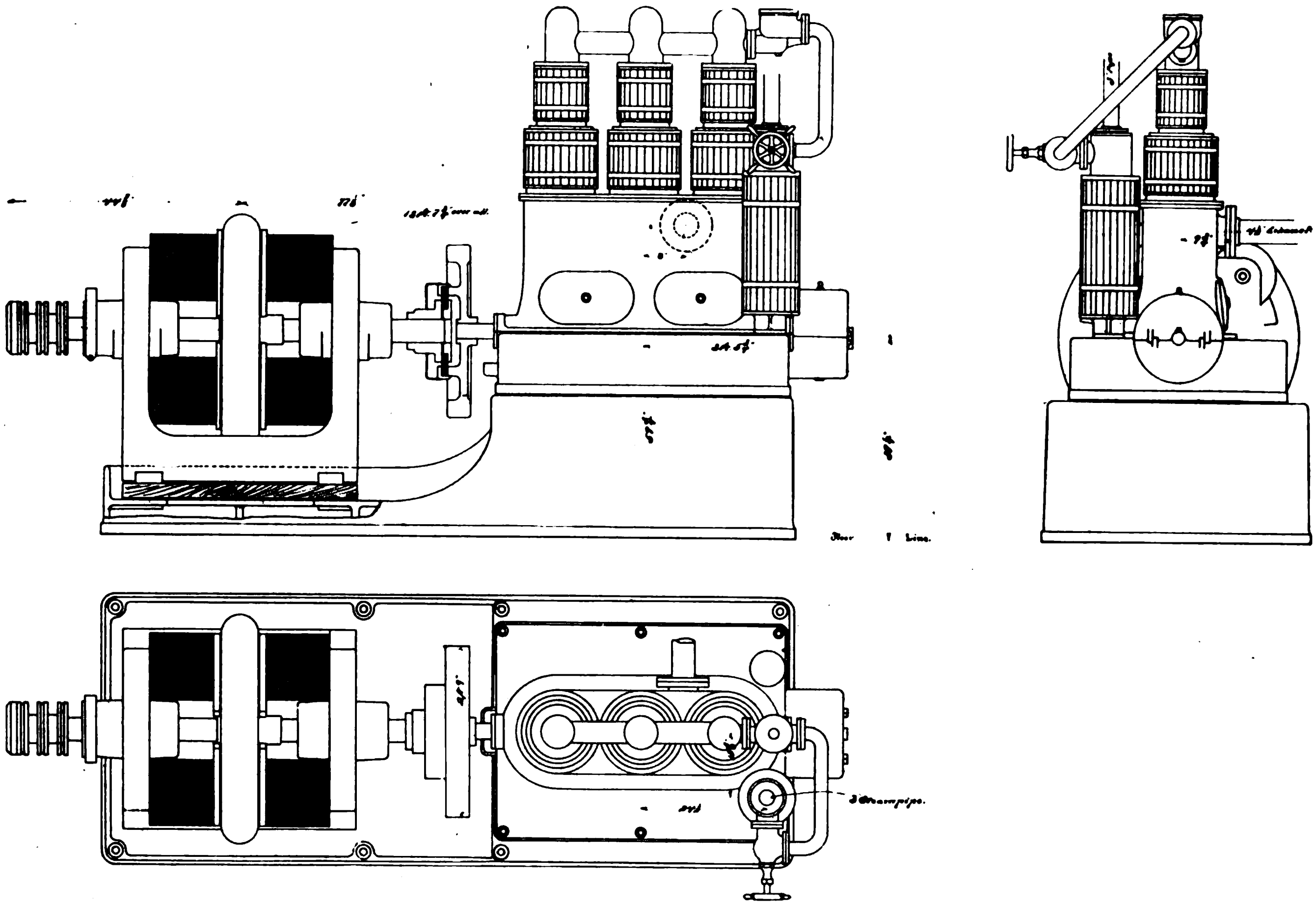


FIG. 7.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL ELECTRIC LIGHT AND POWER COMPANY—DETAIL OF ENGINE AND DYNAMO.

The M. C. Bullock Manufacturing Company, of Chicago, which is the American maker of the Willans engines, furnished the engines and placed them in position, the work being in charge of Mr. W. E. Burgess. To those not familiar with the Willans engine, a brief description may be of interest. The engines differ materially from any others on the market in many respects. They are especially adapted to the requirements of an engine for driving electrical machinery, and are extensively used in electric stations of Europe, being manufactured in England by Willans & Robinson, Ltd. Over 70,000 horse power are now in use. As shown, they are of the vertical type, noiseless in operation, self-lubricating and are extremely compact. All are made either compound or triple expansion and are equally suited for condensing or non-condensing. The engines are made in standard sizes, and all parts are interchangeable. It is a central valve engine, the piston valve moving within a hollow piston rod which passes completely through the line of cylinders and through the ends of the cylinder. The rod is moved by an eccentric on the crank pin. Each line of pistons is connected to its corresponding crank by two exactly similar connecting rods, the valve rod is between them and is moved by the eccentric forged solid upon the crank pin. The reason the eccentric is on the crank pin and not on the shaft as usual is that the valve face, which is the inside surface of the hollow piston rod, moves with the piston. The valve motion consequently required is a motion relative to the piston and this is obtained by mounting the eccentric on the crank pin, which like the piston rod moves up and down with the pistons. All the moving parts of the engine are designed to be strictly in "constant thrust;" the connecting rods are always in compression and never in tension.

The eccentric rod is also intended to work always in compression in the same way as the connecting rods, the holding down power being furnished by the pressure of the steam in the steam chest acting constantly on the uppermost piston valve. One effect of this manner of construction is a very moderate wearing of the brasses, which are kept well lubricated by dipping into the lubricant in the crank chamber. All parts of the cylinders and valves are well drained and the engine has exceptional advantages in this respect. The governor is simple in construction, strong and reliable. It is an extremely close regulator and cannot get out of order so as to cause trouble. To the experienced eye the skill with which all parts of the engines are constructed, the fine degree of accuracy with which they are fitted together, and the finish that is given to the completed machine is an interesting study. If one were to go back of this and watch the selection of the iron and the skill with which the crude iron is transformed into the various parts that make up the engine, some forged, some cast, all made under the trained eye of the superintendent, the experience which the long process requires would be more fully understood.

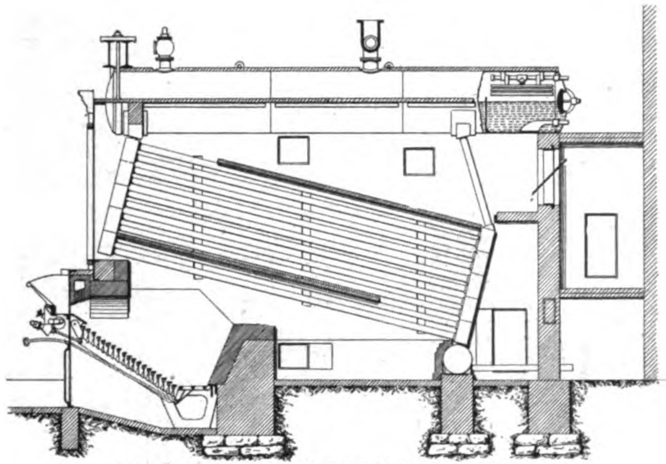


FIG. 8.—ELEVATION OF STANDARD BOILER.

The engine was designed for the operation of electrical machinery, and the original design has been modified as increased experience has shown the need of change. The engine now represents the latest ideas in central station engines. So closely does it conform to the requirements of a dynamo driving engine that nothing seems to be wanting. It runs at the required speed, regulates closely, is economical in the use of steam and is durable. The field which it has entered in operating direct connected arc light dynamos will afford a large demand for engines of this type. The engine will undoutedly have many imitators but the credit of pioneer work in this direction will always be due the engineers of this company, together with those of the Brush company.

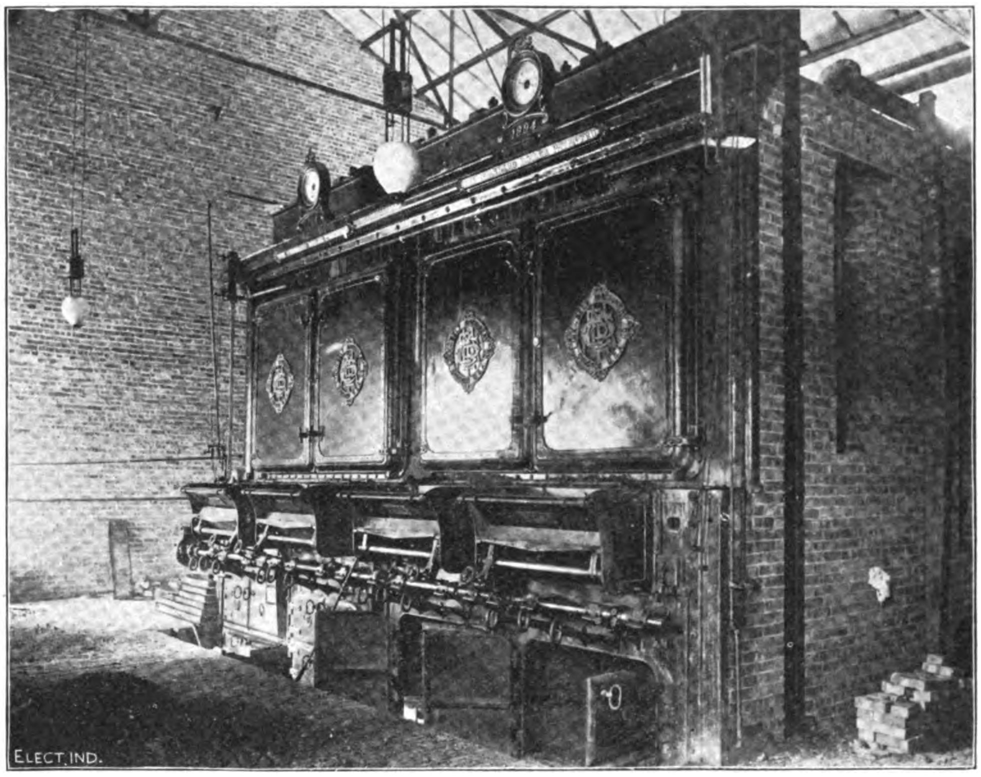


FIG. 9.—THE MODEL ARC LIGHTING PLANT OF THE MUTUAL EL. LT. & PB. CO.—STANDARD BOILERS.

The entire equipment of the boiler room was furnished and installed by the Link Belt Machinery Company. The steam generating plant consists of two 300 horse power Standard water tube safety boilers, heater, pumps, etc. The boilers, a front view of which is shown in Fig. 9 and a cross section in Fig. 8, have each two steam and water drums, 36 inches in diameter, and 21 feet six inches long. placed as shown in the upper part of boilers. Beneath these drums and in an inclined position are the water tubes, 160 in number, four inches in diameter. These tubes are arranged in sections, having cast iron heads for the reception of four tubes, make 40 sections to each boiler· These tubes are 17 feet long. The front end of this battery of tubes is suspended, while the rear end rests on the mud drum.

Each boiler has 3,519 square feet of heating surface. The drums are built of steel, three-eighths of an inch in diameter. The heads are nine-sixteenths of an inch in diameter, and have a tensile strength of 60,000 pounds per square inch. The boiler is tiled just above the lower sections, from the front backward and at the top from the back forward. This method throws the hot air and gases on every part of the tubes and along the entire length of the water and steam drums at the top before passing to the chimney. The heat is thus fully utilized and the gases are retained a sufficient length of time to lose their heat. The pressure of the steam carried is 160 pounds.

The feed water in coming from the exhaust steam feed water heater passes into live steam feed water purifiers in the rear of the water and steam drums. Here there are four pans suspended from the top of shell. The feed water passes over these pans and then over the partitions in the bottom of the drum before it enters the circulation of the boiler proper. The impurities of the feed water are collected back of the partition, where they are easily blown out. The protection thus afforded the boiler by this ingenious arrangement is most valuable.

The furnaces of boilers are equipped with mechanical stokers, manufactered by Westinghouse, Church, Kerr & Co. The coal is delivered from the car to space in front of boilers, from where it is shoveled into the hoppers of stokers. The arrangement is very convenient. It gives a steady fire and the constant production of steam, which is regulated to meet the requirements of the load on the plant. Most excellent service has been rendered, and engineers and firemen express themselves more than pleased with the stokers and furnaces.

The pumps in use for feeding the boiler are of the duplex type manufactured by the Deane Steam Pump Co., of Holyoke, Mass., and were furnished from the Chicago office, located at 226 Lake street. In Fig. 10 is shown this well-known style of pump. The steam cylinders, of which there are two on each pump, are seven and one-half inches in diameter. The water cylinders are five inches in diameter. The stroke is ten inches and the feed water is forced against the 165 pounds steam pressure of the boilers. These pumps have performed their service very satisfactory since they were installed as they have in hundreds of other power plants.

The feed water heater used in this plant is the well known Excelsior, which is a combined feed water heater, purifier, filter and oil separator, and dispenses with the numerous separate devices as heretofore used, and is a very simple and efficient device. Exhaust steam is admitted into the center chamber where the steam is expanded; the oil in the steam is separated by expansion and is drained out, as is also the condensed steam from the exhaust pipe. The steam then rises through the tubes and meets the inlet supply of water as it passes over the receiving pan in a spray, thus heating and purifying the water by direct contact with the steam. The water supply is controlled automatically by the float on the side which maintains at all times the water level in the heater. After the water is heated and the impurities precipitated, a reasonable time is allowed them to settle, as there is comparatively no motion to the water.

The down tubes on the right which conveys the water to the lower or filtering chamber, projects six inches above the head in the upper chamber, so that only those impurities that have been precipitated and are in solution pass to the lower chamber where they are arrested by filtration as the water passes through to the pump. The exhaust tubes in the upper chamber are of much larger area than the exhaust inlet and outlet, and back pressure on the engine is impossible. The piping on the right is for overflow, oil outlet and blow-off. The overflow is six inches below the exhaust tubes and it is impossible to flood the heater. These heaters are built in Chicago by the Excelsior Heater Co., and are sold on a guarantee to accomplish certain results.

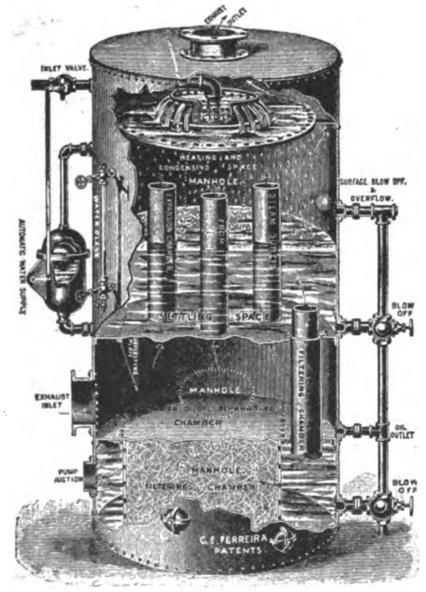


FIG. 11.—THE MODEL PLANT OF THE MUTUAL EL. LT. & PR. CO.—EXCELSIOR HEATER.

The station has been designed so that units may be added as the demands on the plant make it necessary. The three units now installed occupy but a small portion of the floor space; the switchboard can be extended by adding panels at each side, and the boiler room is of sufficient size to accommodate more boilers. In this respect it may be considered but the beginning of the great plant that at no very distant day will be required to furnish light for this great district. Much credit is due to Mr. Authur D. Rich, the treasurer of the company, for the successful starting of this enterprise and for the spirit that has carried the young corporation through the many vicissitudes which have been encountered in reaching its present position.

The company is managed by Mr. McCarthy, who is a young man of considerable experience and whose familiarity with electrical machinery through a long connection with the Brush company, will undoubtedly be found of great value. The superintendent of the station is Mr. A. Thurlby, whose knowledge of central station operation has been gathered through long experience in connection with central station and power work. The station contains a large lamp room where lamps can be tested and repaired, tool room and hall and is equipped with telephone and such other accessories as the business of the station requires. A station so well equipped with machinery of the latest design cannot fail to be successful. Its future is most promising as the large district covered is bound to grow rapidly.

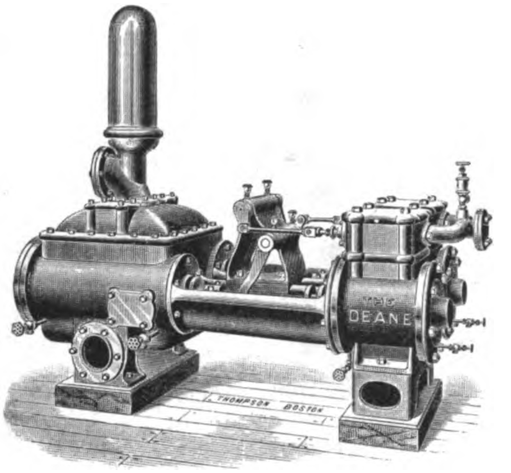


FIG. 10.—THE MODEL PLANT OF THE MUTUAL EL. LT. & PR. CO.—DEANE PUMP.

When the entire plant is considered from beginning to end its excellence becomes more apparent. The finest machinery and the best construction, the latest and best practice in central station construction have produced a plant which is unsurpassed by any in operation. It is certainly worthy of a visit from engineers and all interested in central station construction.

Some Hints of the Building of Electric Plants.—III.

BY CHAS. G. ARMSTRONG.

CONSTRUCTION PERIOD.

In the construction period you will find that the conditions have changed very greatly, from the fact that you have now to deal with men as well as with engineering problems. In dealing with engineering problems certain fixed laws can be followed, but in dealing with men there are no rules that can be laid down except the strict application of the golden rule to deal fairly if you expect to be fairly dealt with.

The character of the contracting company is always clearly defined in the action of its employes. I do not mean by this that because one or men employed by a company are dishonest that the company is dishonest, but the general policy of the various contracting companies is echoed through the entire conduct of its employes, as a whole. It often, and I might say generally, happens that those who were the most anxious to get the contract and were the most willing to promise everything before the signing of the same, immediately upon beginning construction commence to find that vast improvements can be made here and there and that such improvements call for an extra of more or less magnitude. It is at this point that great care and judgment must be exercised, for during the progress of the work it is no uncommon thing to have many improvements suggest themselves to you, or be suggested to you by others, that are worth the extra investment. It may be that certain changes can be made that will lessen the cost of construction and yet materially increase the value of the completed plant, and it may be that some extra expense may also enhance the value of the plant, but more often the additions suggested are only to pave the way for extra compensation.

The greatest fault to be found with superintendents of construction is the liability to insist strictly on the terms the wording of the contract rather than the intention and meaning implied. One must not forget that to say exactly what one means is a most difficult task. The writer once had occasion to remind an inspector who was insisting that certain rules framed by him were very clear and could be easily understood, that the Constitution of the United States which is probably the best piece of English that has ever been executed in the last 200 years, has required the combined efforts of our brainiest lawyers from time to time during its existence, and has not yet been fuly intrepreted.

Experience, common sense and good judgment must be continually brought into play in the installation of an electric plant. The tendency to be arbitrary and to insist on certain fixed rules is a very dangerous one and should be avoided by all inspectors who wish to make for themselves a reputation. It does not follow that a plant installed by certain fixed rules would be better than one that is installed by an intelligent and experienced designer. The one injects a plant into a building without judgment or thought of the fitness of things, and the other moulds, shapes and deftly adjusts the various parts of his plant to the immediate nature of its surroundings.

Generally speaking, reduce the wire to the lowest possible amount; reduce the number of cut-outs to a minimum; conceal your wires as far as practical but have them accessible. The writer devised some years ago, especially for large buildings, a combined system of moulding and interior conduit tubes; these mouldings are now being made in non-combustible material, and interior conduit tubes can also be obtained manufactured of non-combustible material, both can be arranged in such a manner that the amount of tubing is very small indeed and while every wire is concealed it is readily accessible. The designer should insist on non-combustible cabinets; upon as few joints in the wire as possible; in distributing wires it is not necessary to have any joints, and as far as practicable the work should be done on the loop system, although with the moulding mentioned taps can be made for the brackets without resorting too much to the loop system, as they sometimes become very cumbersome.

The cut-out blocks used in the cabinets should be of some glazed pattern and the backs or rough parts should be painted with some water proofing paint. This is necessary as the unglazed portions of the blocks will quickly absorb moisture.

As to the system of wiring which you employ it will depend on the company with which you contract. There are few cases where you will need to use the three-wire system in an isolated plant, the two-wire being very much less complicated and easier understood by the average operative; however, it is often necessary to use a convertible three-wire system in cases where a three-wire municipal plant is being operated and where there is a probability of using current part of the time from the municipal plant; in such cases throw-over switches can be placed on the switch-board, which will cut off the isolated plant and throw the municipal plant into service. Of course in the convertible system the neutral wire must be made equal in cross section to the sum of the outside; this is confined to the risers only, as the distributing wires can simply be grouped in such a manner as to balance the load near enough for all practical purposes.

In municipal lights where a considerable distance is to be covered, the alternating current is the most desirable, not alone by reason of its convertibility from high to low tension but for another reason which has been greatly overlooked by most writers on this subject—the less danger from grounds. The writer once overheard a conversation between two insurance men on the danger (?) of electricity. One of them stated that he had just learned that a ground over on the North Side had caused a fire on Wabash Ave. on the South Side, some two miles away. While this statement was somewhat at variance with the truth yet it is undoubtedly true, that with a continuous connection between all of its wires, main, distributing and otherwise, a ground at one point makes a strain to ground throughout the entire plant, and a weak spot on the opposite pole might give out and cause a leak of more or less magnitude, and fire danger. With the alternating current there is a break in the continuation of the connection at each transformer, so that a ground on a building in one portion of the city creates no tendency to ground on any portion except its own immediate surrounding, i.e., the lamps fed from the transformer upon the secondary of which the ground appears.

As to the arrangement of the plant, the inspector should aim to group his dynamos in such a manner that the switch board is readily visible from any commutator, and to have the shortest distance possible between the dynamos and switch-board for in throwing machines in multiple it is sometimes necessary for the operator to reach the commutators of some machine in the shortest possible time to prevent serious sparking or injury to the same.

In superintending the building of foundations the designer can save himself a great deal of trouble and his client a great deal of expense by a close scrutiny of the methods pursued by the contractor for this class of work. It is usual for electrical contractors to sublet the building of foundations, and for some unexplainable reason the class of men doing this kind of work, do not, as a rule, appreciate the importance of building good foundations. The greatest of care should be exercised in the selection of material as much depends upon the quality used. The experience of the writer has been that the best quality of German Portland cement is none too good for an engine or dynamo foundation and greatly prefers concrete to any other form of foundation, as it adjusts itself readily to shape and the conditions required and if properly built, is as firm as a rock.

One of the greatest difficulties to be confronted by the inspector is the operation of the plant during construction. It very often happens that it is necessary to light or otherwise operate a portion of the plant during the course of construction and one or more dynamos and engines will have to be set in place and covered with a temporary housing; temporary connections will have to be made and a temporary switchboard erected in order to accomplish this purpose. Once in the experience of the writer he was compelled to operate three plants in multiple some 2,000 feet apart from each other, somewhat in the form of a triangle, in order to supply sufficient current during the course of construction. This was occasioned by the tearing out of two old plants and the substitution of a central station plant. In this case a part of each of the old plants and some of the new was required to keep up the extra lights necessary.

The operation of different plants in multiple can easily be accomplished by running pressure lines from plant to plant and a proper arrangement of voltmeters. It would always be best if possible to completely install a plant before operating any part of the same but this is seldom possible. Almost invariably current will be required and part of the plant will have to be started first. Extra care must be exercised to prevent bearings heating from accumulation of dust and to prevent short circuits and other accidents. Eternal vigilance is not only the price of freedom but the price exacted from the designer and inspector of a well constructed plant. It is during this period, the partial operation of the plant, where the inspector must use a large degree of discretion in dealing with his contractor and in settling disputes between his contractors and others engaged on the building.

Owing to the somewhat frail nature of electrical material the electrical contractors are generally at the mercy of the plasterer, the tile men, the plumber and what not, whose class of work is such that a slight damage is of no vital interest to him, whereas with the electrical contractor a very small nail penetrating the insulation of his wires (and who ever heard of a nail that wouldn't if it got a chance), may partly or entirely destroy his whole plant. The late additions to electrical wiring, the tile moulding and iron armoured interior conduit tubes, however, give the electrical contractor some standing among the building trades, as his work is not so easily injured and his wires, the most frail portion of the plant, need not be installed until the rougher work has been completed.

The best stage for wiring a building is about the time the carpenters are putting up the finishing work. At this time the plastering is all done, the tile men have left the building, and the plumbing and steam fitting is practically done. If the tubing and tile work has been properly done, the electrical contractor can come in with a good force of men and install his wires quickly, safely and cheaply. Every electrical contractor realizes the importance of a careful handling of wires. From its plastic nature, the insulation of a wire is necessarily frail, and in uncoiling the wire from the reel or bunch, as the case may be, the wiremen often jerk, twist and kink it in such a manner as to permanently injure and destroy its insulation properties at various points. Wire should be handled carefully, and unreeled so as to bend its insulation as little as possible. If in bundles, the bundle can be held on the arm of a workman and the wire fed out to the workman who is inserting it into the tube and moulding. It can be put into position in this way with scarcely any bending, and the quality of the entire installation greatly increased.

As to the number of lights on a circuit, authorities disagree. Like many another problem, its solution depends on the local conditions, for instance, in cases where lights are to be turned on and off as a unit a large number of lights can be placed on a circuit; where they are to be handled individually, where the keyless socket is used (and it would be better if we could always use the keyless socket), a larger number of lights can be installed on one circuit than where the key socket is used. The only object of restricting the number of lights on a circuit is the liability of the socket being destroyed by a short circuit in the same, i.e, the fuse which protects the whole circuit should be small enough to blow and open the circuit rather than to have the short circuit destroy the socket wherein it occurred. In the case of motors, as a matter of course, the current should be limited to the capacity of the smallest motor on the circuit in the same way as described above for sockets.

If possible, during the construction period, the designer should have under his tuition the person or persons who are to operate the plant, in order, first, that they will be familiar with the general design and exact locations of all mains, feeders etc, and second, that he may be instructed fully as to the peculiar traits and characteristics of the apparatus he is to operate. If he is the right kind of person he will be competent at the close of the construction to assume charge of the plant and to operate the same in a creditable manner, upon which operation so much more depends than is generally appreciated by owners, and upon which subject the writer will say more in the next issue.

Obituary.

RUDOLPH EICKEMEYER.

At Washington, D. C., on January 23, Mr. Rudolf Eickemeyer, an inventor and prominent citizen of Yonkers, N. Y., died. He had left for the south, being in poor health, to escape the severe weather at his home, and, while stopping at Washington, became ill. Born in Bavaria he came to the United States in 1850. His first enterprise in this country was a tool-repairing factory, and his first inventions were in connection with hat making. These machines are everywhere used. Dynamos, motors, electric railway system and many special parts of machines, are among his electrical inventions. There seemed to be no limit to the number of his inventions. The royalties from his patents made him wealthy. He had for a number of years been president of the Board of Water Commissioners.

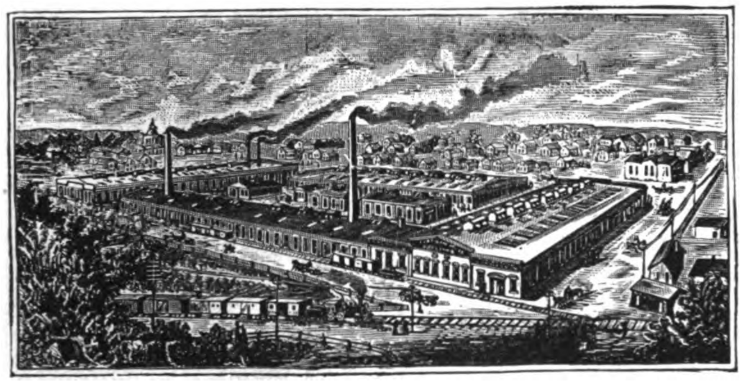
A. H. BAUER.

At New York on January 15, occurred the death of Mr. Alexander H. Bauer, chief electrician of Pullman's Palace Car Company. The cause of his death was Bright's disease with which he had for some time been afflicted. Many of the electrical devices that now contribute to the comfort and elegance of the Pullman cars are of Mr. Bauer's invention. He had risen to the position he occupied through the many sterling qualities he possessed. A thorough student of the practical problems he took an active interest in the progress of the industry. He had a large acquaintance and was a member of the American Institute of Electrical Engineers. The funeral took place on Thursday the 17th, at Baltimore the city of his birth and where he resided for a long time as manager of the Gold and Stock Telegraph Company, of Baltimore, and the Mutual Union Telegraph Company, of Baltimore. His connection with the telegraph commenced with the breaking out of the war in 1861 when he was assigned to Annapolis Junction. During the war he held positions at many stations in that section and in 1864 entered the employ of the United States Telegraph Company. Mr. Bauer was for a time connected with the Electric Storage Battery Company and the Accumulator company previous to his acceptance of the position with the Pullman company. He made a careful study of storage batteries and was well posted on the subject, having examined foreign batteries as well as those on the American market.

CLEVELAND, OHIO, ITS ELECTRICAL AND ALLIED INDUSTRIES.

Cleveland, the Forest City, is one of the most prosperous of the cities along the lakes. It was founded in 1797 by Moses Cleaveland from whom it takes its name although the name has been shortened by dropping the "a" from the first syllable. Now a city of more three hundred thousand its citizens promise to number four hundred thousand when the next census is taken. A wealthy city with natural advantages it is the center of many of the most important industries of the country. It has many pleasant homes, beautiful parks and drives and is considered a desirable city of residence.

Cleveland has one of the most important lake ports and ten railroads center there. To its excellent transportation facilities is due the rapid growth of the city. The freight handled by the lake boats is about one-tenth of that of the railroad lines. The coal and iron trades are the most important centered at this port. The amount of capital invested and men employed exceeds that of any other line of trade. Besides the ore and pig iron received and shipped from this city, manufactured iron is a most important product. The works of the city produce enormous quantities of rails, structural iron, etc. The annual shipments of coal from this port exceeds three million tons. The oil trade undoubtedly ranks next to these industries. The oil fields of Ohio are connected to Cleveland by pipe lines and the oil refineries located here are among the largest in the country. Among the interesting sights of the city are the ship yards, docks and the yards where the immense quantities of coal and ore are unloaded and transferred.



WORKS OF THE BRUSH ELECTRIC COMPANY.

While the advantages of its lake port, its many lines of railroad, the immense quantities of freight handled, its iron industries and large manufacturing establishments are of general interest, to the central station man Cleveland is looked upon more as the birthplace of the modern arc lamp and central station lighting. It was from here that it was announced that Mr. Charles F. Brush had perfected apparatus that enabled him to burn a number of arc lamps in series from the same dynamo. From the apparatus there constructed has grown the wonderful industry which the National Electric Light Association now represents. As the electrical industries grew Cleveland became the home of other companies engaged either in the manufacture of electric apparatus or supplies and it has remained a center from which electrical goods have found their way to all parts of the globe.

THE BRUSH ELECTRIC COMPANY.

On February 19, 1872, the Telegraph Supply & Mfg. Co. was incorporated. Its business was largely in furnishing electrical supplies in the line of call bells, etc. In 1875 Mr. Charles F. Brush began his experiments on electrical machines and apparatus, and in the next year completed his first arc machine. His experiments were continued during the following years, and under Mr. Brush's directions the company built a number of machines. When the arc lighting apparatus was sufficiently perfected for commercial use the Brush Electric Company was incorporated and the manufacture of electrical equipments was begun.

The business has since gradually extended, and although arc lighting machinery has remained the specialty of the company other lines of electric machines and appliances have been manufactured. A view of the extensive works of the company is shown in the accompanying cut. They are located at the corner of Mason and Belden Sts., on the line of the C. & P. R. R. The present officers of the company are: President, W. H. Lawrence; first vice-president, Mr. C. A. Coffin; second vice-president, S. M. Hamill; treasurer, B. F. Miles; secretary, A. H. Hough; general counsel, W. B. Bolton; assistant general manager, L. H. Rogers; manager sales department, A. D. Dorman, and superintendent of factory, C. W. Phipps.

THE WALKER MANUFACTURING COMPANY.

The Walker Mfg. Co. has long been known as a maker of power and cable machinery, and more recently as a manufacturer of electric railway generators and motors. The Walker street car motors are now in use on a number of important roads, and the generators are in use in many power stations. In accommodating this department the works have been considerably enlarged and experienced electrical engineers added to the staff of the company. The reputation which the company has always maintained as the maker of high grade and reliable machinery, is sustained in this department. The company has always made Cleveland its headquarters where unexcelled shipping facilities have been secured, and an abundance of the raw materials has been at hand. The products of the company are distributed throughout the United States, and many of their special machines go to foreign countries.

THE NATIONAL CARBON COMPANY.

One of the most important supplies used by the central stations is the arc light carbons, and a visit to the extensive works of the National Carbon Company in Cleveland will be of great interest to such as find an opportunity during their stay in Cleveland while at the convention. The National company is one of the oldest in the field, and its carbons are known almost wherever arc lights are used. while arc light carbon are the principal product manufactured, yet the company manufactures large quantities of battery carbons, motor and dynamo brushes. The main office and factory of the company is located at the corner of West Madison and Highland avenues.

THE BUCKEYE ELECTRIC CO.

This company erected and began the manufacture of incandescent lamps in 1890, soon after it was incorporated, which occurred in February of that year. The business of the company rapidly increased and its lamps soon found their way to every section of the country. In the

(*Continued on page 40.*)

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

The event of the present month of interest to all connected with the electric lighting and power industries is the annual convention of the National Electric Light Association to be held at Cleveland, O. The indications at this early date point to a large attendance. The location of Cleveland with respect to the different parts of the country is such that it is easily and conveniently reached. Arrangements with the different passenger associations, already completed, provide special rates for all attending. Central station men may look for a warm welcome at Cleveland. All who can possibly do so should plan at once to attend this convention. The advantages of membership in this association and of being present or at least represented at its annual meeting are often overlooked. Sometimes it is through indifference or but a partial appreciation of these advantages and often it is through the pressure of business that makes it inconvenient to get away for a few days. Whatever it may have been heretofore let this year be an exception and be present at Cleveland on the 19, 20 and 21st of this month.

The National Electric Light Association, as it has increased in size and strength, has increased the individual benefits which it has given its members. Its claims for support from every electric light company are the best of business reasons. Aside from the prominence and strength it gives to the industry, the assistance to the individual station is of sufficient importance to warrant every station in becoming a member. Its field is not limited to any section of the country, but covers the entire United States. The success of the association and good work accomplished should be matter for congratulations among its friends. To its agency is due the distribution of many of the ideas of operation and methods of management which have enabled the industry to reach its present position of prominence. The annual gathering, the interchange of ideas, the discussion of timely topics, the presentation of new appliances, the exhibition of new apparatus and the enthusiasm which is always present give everyone fortunate enough to attend an ample reward. At the coming convention subjects such as the past year has brought to the attention of the members will be discussed. New problems have been uncovered and many of the old ones have been brought more forcibly to mind. The question of economic power is always a subject for discussion, and new forms of competition, together with a multitude of other questions which have come before the industry during the past year, will call for solutions at this convention. Each convention adds to the usefulness of the electric lighting and power industry. In fact, through the work of the association we may trace the growth of electric lighting from a few central stations at widely different points to its present magnitude, when there is scarcely a city or town of any size which has not an electric lighting plant, and isolated plants are a part of nearly every engine-room. The association has a brighter and more useful future before it. Central stations should not fail to participate in the work of the association, and will find the time spent to yield a profitable return.

The electrical catechism, of which the first installment appears in this issue, is designed to answer the numerous questions that continually come up in the minds of those who come into contact with some application of electricity. The questions are selected from personal inquiries and letters and are gathered from a variety of sources which show the needs of electrical workmen, superintendents, engineers, dynamo tenders, wiremen, motormen, lamp trimmers, inspectors, mechanics in repair shops and others. It is the intention to cover a wide range of subjects connected with electricity. Suggestions and questions will be welcome from any source and care will be taken to give each a correct answer. It is not expected to present much that could not be found somewhere if one only knew where to look. It is hoped that many who have not the time or opportunity to study the books, will find at least some of the knowledge they desire presented here in a convenient form and in a style that will prove attractive.

The convention of the Northwestern Electrical Association at Milwaukee last month was most successful in every respect. The attendance was good, the subjects discussed were timely and important to the central station manager and the interest taken in the meetings was all that could be desired. Central stations of the northwest that were not represented missed a most profitable convention. The problems that the managers have to solve are similar. The operation of the station, the customers supplied, the attitude of the city councils and the competition of old and new illuminants and devices, present questions which every manager has to answer and the experience in one city is quite apt to be that in another. The discussions at these meetings bring out the different ways of handling these questions and enable one manager to profit by the experience of another. The united action of the association on any important matter will accomplish more than any number of individual efforts. These facts should be brought to the attention of every central station owner and manager in the northwest and, if possible, induced to attend the next convention at Chicago in July. The growth of the association has been rapid. The men of this territory are active and energetic and they have taken hold of the association as they take hold of every worthy enterprise. The officers of the association have been faithful to its interests and it is now on a secure basis.

The discussion of the Milwaukee convention of the "Incandescent Lamp vs. Welsbach Burner" showed a diversity of opinion as to the importance of the Welsbach burner as a competitor. The experience of the members was that the burners were being adopted by certain classes of customers by reason of the cheapness of the light. Up to that time the burners had not been given a sufficient trial to show whether they had come to stay or were capable of but a short life. A few central station men reported that customers were coming back who had tried the Welsbach burner and found it troublesome, and expensive, the breaking of the chimney and mantles incurring an expense that overbalanced the cost of incandescent lights. Sometimes the burners burned well for a certain length of time but a series of accidents sent up the expense account. Records kept of the breakage for several months show that several burners averaged each a little more than one chimney and a little less than one mantle per month. While the color of the light for interior lighting is bad, experience shows that it is used by certain classes of customers, the peculiar light being considered advantageous for advertising purposes. In other places the color gives a ghastly appearance to everything in the room and it would not be used at any price. Decorations, pictures and colors of all kinds are given a painful appearance. The discoloration of the ceilings and hangings of a room is nearly as bad as with the old burners and the air is filled with impurities in the same manner. The burners have come as a novelty but as soon as this wears off its defects will be too apparent for its use. Persons attempting to read by this light are astonished to find that the type does not appear plainer which is due to the peculiar color of the rays given off. The economy and efficiency of the lamp are certainly not well established.

An increase of new telephone companies has been noticed since the recent decision on the Berliner patent, and greater activity is apparent in telephone circles. There is a large field open for telephones, especially for private lines, hotel service and small exchanges. This field has remained unnoticed by the original company. The line of goods produced by the newer companies adapted for this service has met with a large sale. There is a sharp rivalry among them for the possession of the field, and in some of the cities there are already several exchanges under way. The prices given are very attractive, but the value of the service which will be given, it would seem, has not been very carefully considered. With two companies in a city and the subscribers divided between them, it is evident that the value of each is but one-half what the service of one would be had it the entire number of subscribers connected. With a more careful study of the situation and an investigation of the merits of the systems offered, one exchange in a city might be secured that would give a service such as two exchanges could not, and at a reasonable price to subscribers. In the cities where there are two telephone companies it will be necessary for many of the business houses to have two instruments in their office. The expense, instead of being reduced, will thus be greatly increased.

The manufacture of telephones and exchange apparatus by new companies is beset with many difficulties. Especially is this true with those intended for exchange service. The patents owned by the American Bell Telephone Co. and the Western Electric Co. are so numerous and cover in such general terms the many appliances and combinations of the telephone that the construction and operation of telephones and exchanges has to be done with great care in order to avoid the infringement of the patents of the above companies. Several suits have already been instituted against companies who have recently installed exchanges. Although some of these patents have but a few months to run and others a number of years, it seems to be the policy of the companies to protect their interests and to hold their ground as long as possible. Nearly all the important patents on telephones and apparatus that have been taken out have been purchased by these companies. Since until recently they alone could make use of them, the purchase of the patents was not a difficult matter. The expiration of the fundamental Bell patents a year ago opened to public use the magneto telephone, and the recent United States Court decision published in the last issue of this journal, declaring void the Berliner patent, opens to public use the battery telephone. As far as the principle of the telephone is concerned it is now open to public use. The skill of inventors will unquestionably find means to produce instruments and appliances simple and efficient which will not infringe existing patents and which will give perfect service. It is so much easier to utilize the works of others rather than to undertake the task of working out new devices that many will undoubtedly encroach on others' ideas, and thus make trouble for themselves and their customers. This may occur unintentionally, owing to the uncertainty of the ground really covered by patents. Another of the patents of the Bell company expired on January 15 last. This patent covered the use of the induction coil, which has been found advantageous in connection with the battery transmitter. Other patents still in force involve the call system, the receiver hook and switch, etc., but probably the most valuable patents are those connected with the switchboard.

The Chicago General Street Railway.

At the annual meeting of the stockholders of the Chicago General Street Railway Co., the following directors were elected: J. H. Wilbeck, L. E. McGann, C. L. Bonney, James P. Black, D. B. Scully, Lyman Payne and Lawton C. Bonney. The officers elected for the present year are president and general manager, L. E. McGann; vice-president, C. L. Bonney and secretary and treasurer, L. C. Bonney.

The company carried during the past year 887,402 passengers on its 14 miles of track. The passengers carried per car mile was 4.37. The cost of operating per car mile was 14.41 cents. For the eight months of the operation of the road ending December 31, the following is a statement of the receipts:

Cash fares	$27,537
Ticket sales	13,010
Miscellaneous	320
Suspense account	4,679
Gross receipts	$45,546
Disbursements—operating expenses:	
Maintenance	$2,281
Transfer station	17,327
General expenses	3,543
Suspense account	4,714
Total	$27,866
Cash on hand account interest	8,750
Surplus	8,930

The company has recently received 25 new cars, which are modern in every respect.

Now that the inventory season is over, a good many firms find they made "a little money" last year. Old 1894 was not such a rascal after all.—Hide and Leather.

(*Continued from page 37.*)

summer of 1892 the business had grown to such an extent that the original factory did not afford sufficient facilities to meet the demands of the trade. A large three-story brick structure was then erected and was ready for occupancy in January, 1893. The factory at this time had a capacity of 2,500 lamps per day, and its trade was constantly increasing. The merits of the Buckeye lamp were becoming known and the demand indicated that it would soon be necessary to build another addition to the factory. In the summer of that year, however, on account of litigation with the Edison company, the factory was closed, and was not reopened until January, 1894, when the litigation was ending favorably to the Buckeye company. The factory was soon after greatly enlarged and its capacity increased to three times that which it previously had. The buildings were well designed and built of brick in a substantial manner. The affairs of the company are in the hands of the following officers: President, Mr. J. Potter; vice-president, Mr. O. M. Stafford; the secretary and treasurer is M. C. H. Rockwell and the superintendent Arnold Spiller. The company has a paid-up capital stock of $300,000 and is conducting a business which is in every way successful.

CLEVELAND ELECTRICAL MANUFACTURING CO.

The American watchman's time detector, the original electrical time detector and many other similar products, are manufactured by the above company. The business, which it has been conducting since 1880, when the company was organized with a capital of $150,000, for the purpose of manufacturing these goods. Since that time the operations of the company have greatly extended and and their watchman's time detectors are now used not only in all parts of the United States, but also in many foreign countries. A general electrical construction and jobbing business is also done by this company, which has grown to considerable proportions. The president of the company, Mr. M. M. Hobart; the vice-president, treasurer and general manager, Mr. Arthur B. Foster, and the secretary, Mr. W. C. Walker, conduct the business of the company. Its main office and works are located at 44 and 46 Sheriffs St., in this city, while offices at Chicago and other important business centers look after the local part of the business.

THE KING BRIDGE COMPANY.

Cleveland contains some of the largest plants in the country manufacturing structural iron and steel. Among these is the King Bridge Company, whose plant covers an area of 155,000 square feet. It has to its credit an experience of thirty years in the manufacture and erection of iron and steel structures. Besides bridges and work of a similar kind the company does an extensive business in the manufacture of iron buildings, roofs, etc. The demand for a fire-proof construction in central stations has been met by this company and an extensive business is done in this class of work. The company has exceptional facilities for securing material of the best quality, which, together with the complete plant which they possess, enables them to furnish work quickly and at reasonable figures.

PARAGON INSULATING CO.

This company, although incorporated in June, 1894, has been in business for a number of years. The products for which this company is known are manufacturing from petroleum. The first product was an asphaltuk for covering weather proof wires and cables, and also the making of conduit, being made in a number of grades to meet the various demands of the manufacturers of the above articles. The company has since placed on the market an insulating paint and insulating compounds which are extensively used. The petroleum gives the paint a value on account of its oil-proof quality that is not possessed by others not made from petroleum as a base. The paint is used as an insulator in the manufacture of dynamos, motors, for the painting of moldings, wooden switchboards, iron frames, the inside and ouside of switch boxes, lightning arrestors, etc. The manufacture of these goods, necessary in the construction of almost every electrical machine and piece of apparatus, has steadily increased since the business was started. The value of these products is due largely to the peculiar way in which the petroleum is used. The officers of the company are as follows: Mr. J. B. Meriam, who has for many years been in the petroleum business, is president; the treasurer and general manager is Mr. E. B. Meriam, and the secretary is Mr. F. E. Abbott.

THE HILL CLUTCH COMPANY.

To users of clutch pulleys and power transmission machinery, the Hill Clutch Company is well known. The extensive works of the company have been located in this city for the past ten years and all kinds of power transmission machinery has been manufactured. The president of the company is Mr. H. W. Hill; the vice-president, Mr. Frank Billings; and the secretary and treasurer, Mr. Z. M. Hubbell. The company maintains offices in both New York and Chicago, from which business centers the extensive business of the company is conducted.

THE OHIO STORAGE BATTERY COMPANY.

This company is a successor to the Ford-Washburn Storelectro Company, which did some most valuable work in the application of storage batteries to street railway service. The present company confines its attention to the manufacture of storage batteries under the Ford-Washburn patents. Its accumulators are furnished for incandescent lighting plants in such buildings as it is desirable to light for a certain number of hours when the plant is not in operation, or where such a battery is desirable to assist during the hours of maximum load. Many special forms of batteries are made for operating fans, sewing machines, dentists' tools, for medical use, etc. The officers of the company are located at 52 Wade Building.

THE BODIFIELD BELTING CO.

Cleveland also counts among its manufacturing companies the Bodifield Belting Co., which does an extensive business in the manufacture of belts for power transmission. The company does a large business, extending throughout the large territory tributary to Cleveland. The power plant of the Cleveland Electric Railway Co. uses the belts of this company exclusively, and the plant of the Cleveland Electric Illuminating is now being equipped with belts of a similar kind. During the past six years the company has furnished a large quantity of electrical belts to stations in this territory. The reputation of the belts has become well established, and its business for the last three years has averaged over $125,000 per year. The officers of the company are W. H. H. Peck, president; C. C. Arms, vice-president; C. T. Bodifield, treasurer and general manager; M. M. Lamb, secretary. The company's works are located at 26½ So. Water St., Cleveland.

Mr. Charles Dobbs has been appointed receiver of the Lewis & Fowler Manufacturing Co., of Brooklyn. This company has been a large manufacturer of street cars, fare registers, car stoves, trimmings, etc. What will be the future of the company has not yet been announced.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Electricity for Mechanics.

BY GEO. CUTTER.

As a mechanic I feel like conferring with fellow mechanics on the interesting theme of electricity. Do not consider electricity a subtle, mysterious, force differing in all its laws from those of the mechanical forces. All forces are subject to similar laws and we will all understand electricity much more clearly by considering it the same as we do the mechanical forces which we are using every day. A furnace man well appreciates the three factors of quantity, pressure and time in laying out his work, and he knows that he has resistance to overcome in distributing hot air through a set of pipes. The peculiar problems of his trade are no simpler than those of electricity and they are very similar. The steam fitter also used the same three factors in his trade and would not put up a half inch pipe to carry steam 50 lbs. pressure, 200 feet to a 100 horse-power engine any more than an electrician would put up a number 14 wire to carry electricity at 50 volts pressure 200 feet to 1,000 incandescent lamps. The reasons for certain size pipe are similar to those for certain size wire.

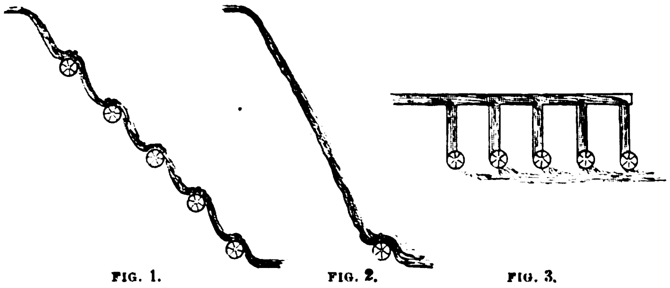


FIG. 1. FIG. 2. FIG. 3.
ELECTRICITY FOR MECHANICS.

Get into the habit of studying the distribution of electricity as you do the distribution of steam and all the problems become easy to understand. Gas, water, etc., are distributed for all sorts of purposes and the laws governing them are similar to those governing electricity. Each trade has, of course, some elements which have to be considered that are neglected in others, but the main laws are common to all and do not require different interpretations except possibly in degree. Air, steam, gas, water, etc., are all treated in pounds pressure. Electricity is treated in volts pressure but the volt is simply a certain definite part of a pound pressure, only a very small part. This is done because electricity is handled so differently as to require a different unit. The pound pressure could be used but its use would be as awkward as the ton would be for diamonds. As a carat is a certain part of a ton so a volt is a certain part of a pound pressure. The reason for different units becomes plainer when we think of the units of quantity. Cubic yards for air, cubic feet for gas, gallons for water, etc. Applied electricity being modern new units were required and scientific societies have adopted same. The problems before them were the adoption of the most convenient units and naming them. The names selected were those of eminent electricians who had helped advance our science to a state where it could become practically useful. As we always consider a resistance to passing air, gas, steam or water through pipes so we do in passing electricity through a wire. The unit of this resistance is the ohm named after the great mathematician who enunciated a simple expression of the relations between quantity, pressure and resistance known as ohm's law.

Momentum and inertia exert quite an influence in water distribution but not very much in air, steam and gas. The reason is obvious; water distribution means the movement of a liquid that cannot be reduced by pressure, but air, steam and gas can be reduced by pressure and they expand very quickly when the pressure is reduced, this rendering them very elastic. The effects of momentum and inertia are used up in the elasticity of the gas instead of producing outside effects which have to be arranged for as in water distribution. Momentum and inertia exert quite an influence in distributions of electricity and magnetism.

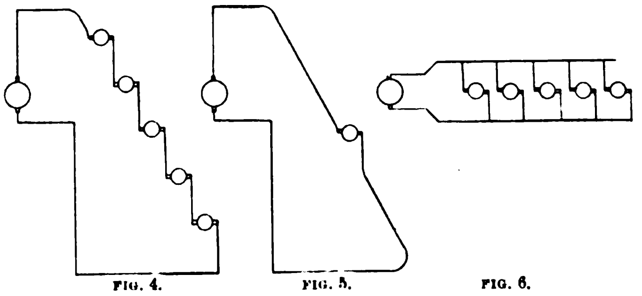


FIG. 4. FIG. 5. FIG. 6.
ELECTRICITY FOR MECHANICS.

This is also easily understood by comparison. Water distribution means the forward movement of the mass of water but electrical distribution means the forward movement of a peculiar mode of motion imparted to the molecules of the conductors. The molecules are very minute and the motions very small but they are exceedingly rapid and we all appreciate the force of inertia in a small body moving very rapidly. A tallow candle shot from a rifle will pass cleanly through a board, all due to its inertia at the great speed. So also with electricity and magnetism the extreme rapidity of the motions cause great inertia which must be considered in practical electrical distributions. And neglect of same has caused many a plant to lose money. The unit of quantity in electricity is called the ampere, that is, the quantity unit most commonly used because it represents the rate at which the electricity is flowing. The other unit of quantity is the coulomb which is simply ampere-seconds. I might say a horse passed my house at a three-minute gait but could not tell how far he traveled without giving the time. A three-minute gait for six minutes makes two miles traveled. A one ampere current for one second makes one coulomb of electricity.

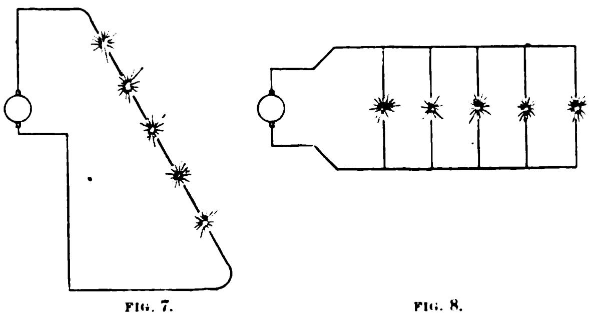


FIG. 7. FIG. 8.
ELECTRICITY FOR MECHANICS.

This unit is misleading and never should have been adopt-as it implies something that can be kept in quantity whereas we only know of electricity by the work it does and this work is all we can store of electricity. But this question belongs to the "doctors" to quarrel over. For our mechanical conception of electricity we do not care whether we call them coulombs or ampere-seconds. We have then the ohm or unit of resistance, the volt or unit of pressure or pushing force and the ampere or unit of quantity. Now let us see how we mix them up in doing our work. The amount of work which electricity does, is determined by the quantity multiplied by the pressure. For example, 5 amperes and 20 volts multiplied gives us 100 volt amperes (called watts); we can vary the phases very much and still have 100 watts. One ampere and 100 volts represent the same amount of mechanical work as 10 amperes and 10 volts. We vary these factors according to requirements. Compare electrical work with water power and this point is easier to understand.

In Fig. 1 is shown a reservoir on the top of a hill with five water wheels located at different points down the hill 50 feet apart. The same water works all five wheels, but 50 feet head being required for each wheel, means 250 feet in all. The same power would be developed by one wheel at the bottom which was built to run with 250 feet head. If however, the wheels were all placed on a lever and fed from a canal connecting with the reservoir and 50 feet head, as before, we would require five times as much water for the same power.

If our reservoir is replaced by a dynamo and one water wheel by an electric motor, the analogy will be plain. If each motor uses 50 volts (instead of feet head), and one is placed after the other in series, the same electricity would work all motors but the dynamo must furnish five times 50 volts or 250 volts. With this same dynamo giving 250 volts, one motor built for the whole 250 volts would give the same power as the other five added together. If, however, the dynamo only gave 50 volts but could furnish more quantity, then we would need five times the quantity to get the same power as before. In one case, Fig. 4, the same quantity with five times the pressure, and the other case, Fig. 6, the same pressure but five times the quantity.

Carry the same idea to electric lamps. In Fig. 7 the dynamo furnishes electricity for five lamps of 50 volts each, the quantity being 10 amperes, five times 50 volts equals 250 volts, and this multiplied by 10 amperes gives 2,500 volt-amperes (called watts); where the dynamo only gives 50 volts however, as in Fig. 8, then five times the quantity will be required for the five lamps, five times 10 amperes equal 50 amperes, 50 volts multiplied by 50 amperes equal 2,500 watts, viz: Same power as before.

All problems in electricity seem plainer by comparison with the forces we are using every day. The momentum and inertia mentioned are chiefly felt in alternating current distributions, and are called retardation, hysteresis, resonance, etc., but they are all easily understood by comparison with the coarser manifestation of inertia.

Electric motors have recently been adopted at the Baldwin Locomotive Works, Philadelphia, and the old lines of shafting have been removed. This makes a great difference not only in the appearance of the works but also in the economy of operation and convenience with which much of the work can now be done. It is estimated that the saving in power is nearly 40 per cent, the power consumed in operating the lines of shafting being a considerable part of that formerly generated.

Wrinkles in Electrical Practice.

BY ALBERT SCHEIBLE, M. E.

"How shall I do this?" That is the question which confronts us in practice many times a day. If it is a serious problem that is before us, one that means a good deal of figuring or planning, we can probably find some help in the electrical books at our disposal. There are now quite a number of volumes touching the most important problems in central station work, wiring or railway work so that we can profit by the published experience of others in these lines. But how about the little points which are not mentioned in these books—points which at first sight seem trivial but which may be just as bothersome as the larger problems? The engine attendant meets such points in his work; the dynamo tender, the station superintendent and the lineman all come across them, and each asks the same question: "How shall I do this?" Perhaps you will say that experience should be the guide, and that such trivial problems should be left to the common sense of the individual. But single-handed experience is a very costly schooling and is not apt to give the best results. If a dozen men go at the same problem (no matter how small it may be) they will solve it in a number of different ways, and some of the methods will be better than others. This is partly because no two heads think exactly alike and also because no two men work under precisely the same conditions. Now if the men who represent various types of thinkers and who are busy under differing local conditions, could exchange "pointer," none of them would be confined to his own experience as a guide. Such an interchange of ideas would widen their experience and allow each one to plan more readily and more economically. What is more, some men will so well solve a simple problem as to develop one of those unique methods which we call "wrinkles" and which mush be known to be appreciated. I want to mention some of these, not as showing any accepted standard but as hints which may save both time and money to the practical reader.

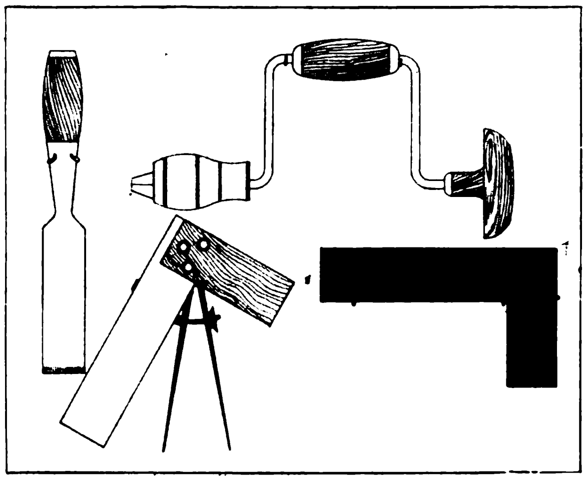


FIG. 1.—WRINKLES IN ELECTRICAL PRACTICE.

(1.) *The Tool Rack.* How can we avoid the loss or the misplacing of our tools? That is probably the most important item connected with their use. It is not enough to have a variety of tools well suited to the average work and in proper condition for immediate use. Of what good are these tools if you cannot find them at a moment's notice, especially in an emergency. To insure this, we must not only have a distinct place for each tool but there must also be some means of making the absence of any tool conspicuous. A very effective way of doing this consists in painting the silhouette of each tool on the wall or shelf on which it rests.

Then as each tool fits exactly over its "shadow," no time is lost in finding its place and the black image is conspicious as long as the tool is not in its proper place. Fig. 1 shows how some tools had been arranged on screwhooks placed on a wall or board. Then the outline of each tool was traced on the back board with a pencil and filled in with black paint. The result is seen in the cut which shows at a glance that the chisel and brace are in their proper places, that the square is out of place and that the dividers are missing. The absence or misplacing of a tool is so apparent that even a hurried workman will notice it and see that the tool is put where it belongs. Of course the same plan can be used for duplicate parts of apparatus, for testing instruments or for any other articles which are kept accessible to a number of workmen.

(2.) *Preventing Rust.* To keep tools and other articles made of iron or steel from rusting, they should be kept in perfectly dry places, where this cannot be done, it is well to give them a coating of some grease or oil which will exclude all moisture from the metal. Ordinary vaseline or petroleum will do, but European metal workers prefer linseed oil. They warm the oil by setting a bottle of it into a can of hot water; then they dip a cloth into the warm oil and rub the tools with this cloth. The articles need not be previously cleaned as the oil forms a coating which protects them just as they are.

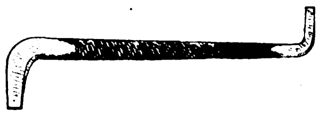


FIG. 2.

(3.) *Special Tools.* If you have much repair work of one certain kind and the ordinary tools are awkward for the purpose, it may pay to make some special tools. Thus in stations having many arc lamps or meters to adjust, a good deal of time is wasted in taking the works out of the casings so that an ordinary screwdriver can be used. The screwdriver shown in Fig. 2 will save this extra time as it can be used without taking the device to pieces. It amounts to a short steel shank with each end bent at right angles so as to form a blade. Such a screwdriver is often very handy and can be made from an old rat tail file.

The Coming Convention at Cleveland.

Arrangements are nearly completed for the annual convention of the National Electric Light Association on February 19, 20 and21, at Cleveland, Ohio. The different parts of the program have been placed in the hands of efficient committees, by which method the work has been greatly simplified and more carefully attended to.

HOTELS.

The headquarters of the association will be located at the Hollenden Hotel, a hotel which is undoubtedly well known to all. The rates there are on the American plan, from three to five dollars per day, and on the European plan, from one to three dollars per day. Other hotels at no great distance are "The Weddell," with rates of from three to five dollars per day; "The Stillman," from three to five; the "Forest City," from two to three dollars; "The Kennard," with rates from two to three dollars per day, and "The American," at two dollars per day. Persons wishing to secure accommodations should have them reserved at an early date, although the hotel facilities are ample to accommodate all.

TRANSPORTATION.

Through the efforts of Mr. C. O. Baker, master of transportation, rates of one and one-third the regular one-way fare have been made for the round trip for all points east of the Mississippi river, Peoria and Chicago. Parties from all the larger cities will go together, and delegates should correspond with the member of transportation committee in their district. For Boston and vicinity Mr. A. C. Shaw, 620 Atlantic avenue, Boston; for Philadelphia and vicinity Mr. H. A. Cleverly, 1801S Chestnut street, Philadelphia; for Pittsburg and neighboring points Mr. E. H. Henrichs, Westinghouse Electric Company, Pittsburg; and for Chicago and western points Mr. E. L. Powers, Monadnock Block, Chicago. The reduced fare is secured on the certificate plan, and when purchasing going ticket all should procure of the ticket agent certificate which, when properly endorsed at the convention will entitle delegates to a one-third fare returning.

Delegates from New York will have a special Wagner vestibuled train on the New York Central & Hudson railroad, which will leave New York at 9.30 A. M. Monday, February 18. It will reach Albany at 1 P. M.; Utica, 3.17; Syracuse, 4.40; Rochester, 6.30; Buffalo at 7.25, and arriving at Cleveland at 11.35 P. M.

The Chicago delegation will go over the Lake Shore & Michigan Southern railroad in special Wagner cars. The train will leave the Van Buren street depot on Monday, the 18th, at 8.45 P. M. Parties from the west will arrive in Chicago in time to go on this train. All from Chicago or western points who can possibly do so should arrange to go by this train and should send their names to E. L. Powers, Monadnock Block, Chicago, that reservations may be made. Information regarding the convention can also be obtained.

THE PROGRAM.

TUESDAY, FEBRUARY 19, 1895.

Meeting of the Executive Committee at 9 A. M., Parlor 138, Hollenden Hotel.

MORNING SESSION, 10:30 O'CLOCK.

Address of Welcome. By Mayor of Cleveland.

President Francisco's Address.

Station Paper by N. W. Perry. The Storage of Energy Essential to Central Economy: How It May Be Accomplished and and the Economies Resulting.

Discussion. John W. Langley, W. M. Stine, M. J. Perry.

Report of Committee on Relations Between Manufacturing and Central Station Companies. Frederic Nicholls, Chairman.

AFTERNOON SESSION, 2 O'CLOCK.

Paper by E. J. Houston and A. E. Kennelly. A New Method of Measuring Illumination.

Discussion. W. A. Anthony, C. D. Haskins, W. S. Howell, Edward Weston, L. Stieringer.

Report of Committee on Data. H. M. Swetland, Chairman.

Discussion. W. R. Gardener, E. L. Powers, H. W. Sexton.

Paper by Walter E. Harrington. Correct Method of Protecting Electric Circuits.

Questions and Answers. What Is It You Wish to Know?

Executive Session.

WEDNESDAY, FEBRUARY 20, MORNING SESSION, 10 O'CLOCK.

Paper by Edward Weston. Some Economies in Electric Light and Power Stations.

Paper by C. N. Black. Large Arc Dynamos.

Discussion. S. M. Hamill, J. J. Wood, F. W. Rollins, E. R. Weeks.

Topic. How to Light Large Cities.

Discussion. Frederic Nicholls, Geo. A. Redman, Jas. I. Ayer, E. F. Peck, C. R. Huntley, Robert Lindsay, F. H. Clark, T. C. Smith, J. F. Morrison.

Report of Committee on Finance. John A. Seely, Chairman.

Questions and Answers. What Is It You Wish to Know?

Executive Session.

AFTERNOON SESSION, 2:30 O'CLOCK.

Paper by E. A. Leslie. The Operation of High Tension Currents Underground from a Physical and Financial Standpoint.

Discussion. H. J. Smith, W. H. Browne, C. H. Wilmerding, John A. Seely, C. L. Edgar.

Paper by L. B. Marks. Arc Carbons and the Rating of Arc Lamps.

Topic. Incandescent Lighting vs. Other Methods.

Discussion, H. T. Edgar, E. F. Phillips, W. S. Barstown, E. A. Armstrong, J. Gwynne, B. P. Holmes.

Questions and Answers. What Is It You Wish to Know?

Executive Session.

EVENING SESSION, 8 O'CLOCK.

Topic by A. J. Wurtz. Practical Demonstrations of Protecting Lines from Lightning.

THURSDAY, FEBRUARY 21, MORNING SESSION, 10 O'CLOCK.

Paper by Dr. Louis Bell. The Monocyclic System.

Discussion. A. E. Kennelly, L. B. Stillwell, J. F. Kelly.

Report of Committee on Rules for Safe Wiring. Wm. J. Hammer, Chairman.

Topic. Underwiters' Rules vs. National Electric Light Association Rules.

Discussion. Wm. Brophy, C. H. J. Woodbury, J. J. Burleigh, A. W. Field.

AFTERNOON SESSION, 2:30 O'CLOCK.

Executive Session.

Report of Secretary and Treasurer.

Executive Committee.

Election of Officers.

Have you noticed the wrapper on your paper with the black thread running running through it? Pull the thread and your paper opens. A very simple arrangement, but practical.

Third Annual Convention of the Northwestern Electrical Association.

The convention of the Northwestern Electrical Association opened on January 16th at the Hotel Pfister, Milwaukee. The delegates were promptly on hand and the first session on Wednesday morning was well attended. The reports of committees, etc., was laid over until the following morning and the members listened to the interesting address of the president, Mr. C. C. Paige, of Oshkosh, Wis. who referred to the growth of the industry as follows: "The history and the development of electric lighting is short, but crowded with famous results of the enterprising people who have been giving it their attention for the last few years. In your deliberations and discussions of the various topics which come before you, I feel assured in the prediction that you all fully realize the magnitude of the electrical industries in our country. There are now over $200,000,000 invested in electric lighting and power plants." Regarding municipal ownership he said in part: "As investors of the money in this public enterprise, I trust you will all see the necessity of a united and vigorously pursued effort to head off, by shaping public opinion, or by legislation if necessary, the advance in this country of those communistic European theories of government ownership of all the public service."

The meeting then adjourned until 2 P. M. The first paper of the

AFTERNOON SESSION

was by Mr. Pliny Norcross of Janesville, Wis., on "Hints upon Daily Work about a Dynamo Plant." In this paper Mr. Norcross explained many simple devices he had successfully used in connection with his plant. In the installation of station machinery the importance of good, dry foundations was mentioned and the necessity of care in the finishing of the armature shaft, the perfect balancing of the armature and he illustrated these points by practical illustrations. Slow speed dynamos with substantial bases, large, accurately turned shaft with large boxes, were favored by him, also the use of wide pulleys, a little larger than was really required. The belt should not be too tight, nor too narrow so as to be over loaded or without enough surface on the pulley. Belts should be kept clean and free from grease. They should be kept pliable by the use of some good belt dressing which should be used very sparingly. For small driving pulleys he advocated the use of wood or fibre. Pulleys may be improved sometimes by covering them with leather, canvas or paper.

Mr. Norcross described a simple device he had found effective where the insulated wires passed through the trees and the limbs moved by the wind would destroy the insulation. The tree insulators on the market he considered too short. The best method he found was to take two pieces of broad 18 inches or two feet long, cut a groove in one of them for the wire and fasten them together under the limb. He thought that the greatest mistake central station men could make was to announce to customers that the electric light was cheaper than gas. The electric light stands firmly enough upon the fact that it is a better light than oil or gas.

Mr. C. E. Burton next read a paper on "Interior Conduit and Interior Wiring." The ideal method of wiring as far as concerns security and insulation is exposed, heavily insulated wire supported upon non-conbustible insulators. Without using interior conduit Mr. Burton considers that concealed wiring should be of such a character as to secure the necessary immunity of life and protection from fire hazard, or enable inspection at all times subsequent to installation. The interior conduit system of wiring was described and the different kinds of conduit now in use. The cost of interior conduit as shown by actual practice was stated by Mr. Burton as being 20 per cent additional for plain conduit, 40 per cent for brass covered conduit. These figures were based on the cost of installing interior conductors by the old method while the cost will not average more than 10 per cent for plain and 20 per cent for brass conduit over the system now required by insurance regulations. The recent concession of the underwriters permitting two conductors to be used in a single tube of iron armored conduit will, it was said, permit a building to be so equipped at an expense less than that for brass conduit.

In the discussion that followed Mr. Gage, of the Washburn & Moen Mfg. Co., called attention to a wire now on the market which had outside the insulating material a fire proof covering that although not as strong as the iron armored conduit, was more flexible.

EVENING SESSION.

At the evening session Mr. William Goltz, of Milwaukee, read a paper on "Incandescent Lamps vs. Welsbach Burners." This paper brought out a lively discussion which was participated in by a large number of those present. Mr. Farwell, who operates both electric light and gas plants at Waukesha, claims that the Welsbach burner is the cheaper light. Others, however, took the other side and substantiated by their experience that side of the case. It was suggested that lamps be replaced before they were burned out to keep up the efficiency of the incandescent lamp. It was the general opinion that the superior qualities of the incandescent light would give it the preference although gas might be cheaper.

Mr. John R. Markle, of Chicago, next read a paper on "Some Characteristics and Economies of Accumulators as Applied to Central Lighting and Power Stations." In this paper the importance to central stations of the storage battery was pointed out. Enabling reductions to be made in the cost of feeders to distributing points on account of possessing a better time factor, and on account of the influence on the load factor, also involving less first cost of generating machinery, greater economy in operation is secured. The space required is less than for steam, air or water storage. Reference was made to plants now in use in which special advantages were secured. The cost of installing is generally misjudged, he said, because of a lack of knowledge of the manufacture of properly constructed elements, the necessary auxiliary apparatus, the expense of placing them on the market, etc. The railway power house offers the most favorable opportunities for storage batteries on account of the frequent and wide variation of the load. In a case cited the saving amounted to 2.2 pounds of coal per horse power hour or a total of $2,500 per year. The amount thus saved would in a few years pay the cost of installing the plant.

THURSDAY MORNING SESSION.

The reports of the committees occupied the first part of the morning session. A committee consisting of Messrs. Norcross, Copeland and Grimm on "Underwriters" was appointed by the chair. The election of officers came next in order. The association was unanimous in its selection of officers and the following gentlemen were elected for the coming year:

President, H. C. Thom, of Madison, Wis.; first vice-president, Geo. Grimm, of Jefferson, Ind.; second vice-president, Pliny Norcross, of Janesville, Wis.; secretary, William Goltz, of Milwaukee; treasurer, Jno. Schuette, of Manitowoc, Wis., and the board of directors, Messrs. F. S. Copeland of La Crosse, O. M. Rau, Milwaukee and E. M. Highland, Clinton, Ia.

The new president having been called upon for an address responded in a pleasing manner, thanking the association for the endorsement bestowed. "I am keenly interested," he said, "in the progress and development of and the good results that can be brought about by this organization. We have been wandering about in an aimless kind of a way but we are getting down to business and I believe that the association's influence will grow continually until the organization will be looked to as a potent factor in shaping the policy of investments and the methods of business."

The report of the treasurer showed receipts since January last of $742.45 and expenditures of $753.46. In selecting a place for the July meeting of the association, Green Bay, Waukesha, Milwaukee and Chicago were considered and Chicago was chosen for the mid-summer convention.

The first paper read at this session was on "Incandescent Lighting on the Meter System Compared with Contract System," by Mr. G. T. Cole, of Beloit. In this paper Mr. Cole outlined his experience in connection with the station in Beloit. The meter system was adopted there two years ago and the result had been most favorable to the company. It was found that by the meter plan customers got just what they paid for. When lights were not needed they were turned out, while on the contract plan they allowed the lamps to burn a greater part of the time. It was also found that smaller transformers could be used for residences. A considerable number of those present took part in the discussion that followed this paper.

"Auxiliary Adjuncts to Electricity," was the title of a paper read by Mr. T. R. Mercien, of Milwaukee. The author explained the workings and value of the auxiliary Gamewell fire alarm system. Attention was called to the importance of having in every building an alarm by means of which the fire department could be summoned without the waste of time in procuring a key and going to the street box.

THURSDAY AFTERNOON SESSION.

The program for Thursday afternoon was the discussion of a number of important topics. Mr. Jno. Schuette opened the debate on "Competition." He spoke of being grounded, crossed and expected soon to be short circuited by the board of aldermen of Manitowoc. The subject of a municipal plant had been aggitated and his method of dealing with the question was explained.

In opening the discussion on "Electrical Business", Mr. Chas. E. Gregory presented some important facts. In this connection he said: "To the superintendent I would say, cheapen the cost of your product by practicing true economy, and a few suggestions along this line may not be amiss. The production of steam being the chief item of expense, the operator should know what furnace, boiler and grate afforded the greatest evaporation for the dollar expended. The engine for transforming your steam into power, the generator which is to transform the initial horse-power into the watt which you sell to your customer, the workmanship employed in your distributory system, the efficiency of the lamp furnished, are all worthy of very careful consideration."

Mr. Davis, of Neenah, opened the discussion on "Water Power." "Water power", he said "had the advantages and would always kill the competition of steam power." Mr. G. Herbert Condict, of Philadelphia read a paper on "A Storage Battery Experience", which was an account of the installation and operation of a storage battery plant at Merrill, Wis., for the Merrill Light & Railway Co. At the conclusion of the discussion which followed this paper the convention adjourned and the members placed themselves in the hands of the entertainment committee.

THE BANQUET.

At nine o'clock, members of the convention, more than one hundred strong assembled at the banquet hall of the Stadt theater. The business of the meeting was finished and all were free to make the most of the program which the entertainment committee, composed of Messrs. T. R. Mercein, A. C. Bunce and T. F. Grover, had provided. When it was time for cigars the toastmaster, Mr. Mercein, after a few remarks called upon Mr. C. S. Ruggles, in the absence of Mayor Koch to respond to the toast, "The City of Milwaukee." Mr. H. C. Thom responded in an interesting way to the toast, "Central Stations." "The Electric Railway" was assigned to Mr. C. D. Wyman, of the Milwaukee Railway. He spoke of the scope of the meeting and the work of the association, reviewed the history of electric railways and gave a very interesting talk on their usefulness. The "Electric Press" was responded to by Mr. Fred. DeLand. The attention of every one was here drawn to the other end of the hall where a troup of variety performers appeared on the stage. This part of the program which was secured through the efforts of Mr. S. F. B. Morse and others, was highly enjoyed by all.

Convention Notes.

Mr. F. S. Terry was on hand to make known the fact that the Sunbeam was again on deck more lively than ever.

Mr. Geo. S. Searing, western manager of the Hart & Hageman Mfg. Co., was a little late in arriving but soon made up lost time.

Mr. James A. Wolf, Chicago representative of the New York Insulated Wire Co., was early in the field and kept "Grimshaw White Core" to the front. He did lots of hustling and it is surmised that he carried away substantial evidence of his work.

The Electrical Engineering Co., of Minneapolis, had on exhibition a telephone equipment and distributed literature on electrical goods.

Mr. F. J. Morawetz, president of the Wisconsin Electrical Construction Company was a familiar figure at the meetings of the convention.

The Metropolitan Electric Co., Chicago, had a display of M. I. R. wires and cables, electrical supplies and specialties in charge of L. W. Burch.

The Chicago General Fixture Co. had an elegant panel displaying the extensive line of supplies and electric fixtures carried. Mr. C. O. Baker represented the company.

The Columbia Incandescent Lamp Co., of St. Louis, was represented by its Chicago agent, Mr. Joseph M. Hill, who renewed his old acquaintances and added many new ones.

The Wallace Electric Co. was represented by Messrs. Max A. Berg and W. S. Hine who found plenty of business as well as pleasure in making new and renewing old acquaintances.

Mr. George Cutter had a line of his specialties, station supplies and telephone goods on exhibition, and renewed his extensive acquaintance among the representatives from the northwest.

The Peoria Automatic Filter Co. had quarters near the assembly hall where Mr. J. A. White could always be found with a crowd to whom he explained the excellent qualities of the Peoria filter.

Mr. M. B. Austin, Chicago representative of the Safety Insulated Wire & Cable Co., of New York, looked closely after the interests of the company as well as for other lines of goods which he represents.

Mr. Herman Andrae, of the Andrae company, was full of business at all times. When not engaged on transportation matters, he became a bureau of information on the convention and the city of Milwaukee.

Messrs. Goltz & Sinclair, electrical engineers and contractors, Milwaukee, were represented at the convention. Mr. Goltz contributed an interesting paper and in other ways helped to make the convention a success.

The Central Electric Co., Chicago, had a very fine display of electrical supplies of all kinds both in the convention hall and in the hotel corridor. The company's interests were well carred for by Messrs. C. E. Burton and H. D. Latimer.

The General Electric Co. had a large display of supplies and central station goods. Two arc lamps were shown burning with Hardmuth carbons. Messrs. A. C. Bunce, M. C. Wheaton and W. J. Ferris looked after the interests of the company.

The Washburn & Moen Mfg. Co., was represented by Messrs. Channing T. Gage and George S. Whyte. The various lines of wire for which the company is well known were displayed and by means of current from a set of storage batteries the fire-proof qualities of Salamander wire were shown.

The Electric Appliance Co. was represented by its president, W. W. Low, who has a large acquaintance with the members of the association. The fine cigars, samples and souvenirs that were distributed by Mr. Low brought to mind the standard goods for which the Appliance company is well known.

The Chas. E. Gregory Co. was represented by its president, Mr. Chas. E. Gregory and manager, Mr. F. J. Baker. To those acquainted with this progressive western house it is needless to say that it was well represented. Many carried away with them portraits of "Four Star Stockholders" of the company, which made a great hit.

S. F. B. Morse & Co., of Kerite wires and cables, gave interesting performances at its headquarters near the assembly hall. Mr. G. W. Patterson, who has appeared in the large cities of the United States, gave some fine exhibitions of electric lighted club swinging, exceedingly fine lighting effects being produced by the colored lamps. These performances were well attended. It is needless to say that the wire used was Kerite.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

The Callender Automatic Telephone Exchange System.

A large part of the expense of the operation of a telephone exchange system is the expense of operators to make the connections. This fact as well as the liability of error on the part of the telephone employes has lead many inventors to the problem of devising an automatic exchange which would give on signal from the subscriber the desired connection. That the problem is not an easy one is evident to all who have seen the interior of a large exchange. In seeking to devise an automatic system, some have pursued one method and others have followed different lines. One of the latest automatic exchange systems is that which has just been exhibited to the public by its inventor, Mr. Romaine Callender, at the Decker building, New York City.

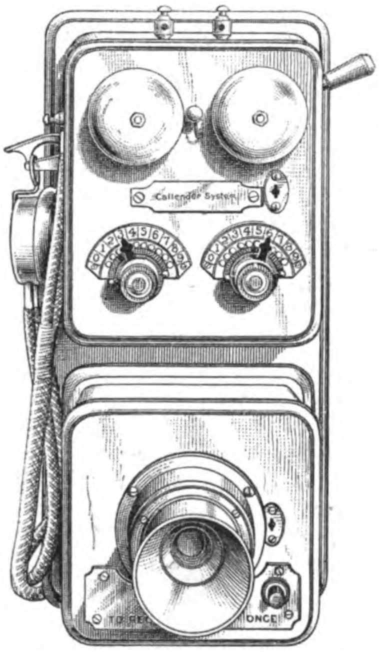


FIG. 1.—SIGNALING STATION.

This system has been termed a percentage exchange system, as it provides sufficient mechanisms for the estimated maximum business at any busy portion of the day. It has been shown by statistics kept in exchange stations that the average number of telephones in use at any one time is only about twenty per cent of the whole. The remainder of the instruments therefore remain idle. In this system a percentage only of mechanisms is provided. The whole of these mechanisms, are, however, for the common use of all telephones in the system. There is a provision by which a telephone subscriber on turning in a call to the exchange individualizes for his own use one of the common mechanisms not in use.

In following out this percentage system a large amount of apparatus is eliminated and the size of the exchange equipment is greatly reduced. The exchange is less cumbersome, but at the same time is of ample size to meet all demands. The apparatus for enabling the subscribers to interconnect themselves automatically at will is divided into two principal portions; first the apparatus at the subscribers station and second, the apparatus at the exchange station. The instrument with which the subscriber is provided is shown in Fig. 1. In addition to the usual transmitter, receiver and call bell, this instrument has a signaling transmitter of special form. As the cut shows it has two dials with a pointer passing over contacts numbered 0 to 9 inclusive, together with a handle projecting at the right hand side. This type of transmitter is used for small exchanges not exceeding 99 subscribers. For the addition of each figure another dial is added. Thus for 999 subscribers, the subscriber's instruments would have three dials and for 9,999 four dials with the same internal construction.

This instrument has been devised with a view to the greatest simplicity in operation of signaling the exchange. It renders the act of turning in a call wholly automatic. A subscriber desires to call up number 8; he turns the pointer on the right-hand dial to number 8 and pulls down the lever. After a few seconds the bell rings announcing that the connection is made. If he desires to call 56 he places the left-hand pointer to 5, the right hand to 6 and then pulls down the lever. Should that member be busy, a busy call or two rings is given instead of the single ring which announces that the connection is made.

With the exception of a simple mechanism for each individual subscriber, the whole of the exchange apparatus is on a percentage basis and this percentage varies in the several divisions constituting the complete system. The different portions of the exchange apparatus are designated as follows: The circuit selector for receiving incoming calls for seizing any of the unused portions of the apparatus and for individualizing to the calling subscriber for the time being, that portion of the apparatus seized; the numerical receiver for registering the number of the telephone with which connection is desired; the numerical separator for separating the sets of impulses constituting the call, so that they are automatically classified into thousands, hundreds, tens and units as they arrive at the exchange station; the numeralizer for totalizing the thousands, hundreds, tens and units registered by the numerical receivers, for selecting the telephone with which connection is desired, and acting also as an auxiliary for bringing said telephone into connection with a line of the signaling subscriber; the signaling track for signaling the subscribers when connection is established, or where a telephone called is in use for signaling that fact to the calling subscriber; progressive switches that are common to all the subscribers which when brought under the control of a signaling subscriber, is held by him free from interruption until the several steps making up the connection have been effected, and the connector having a plurality of conductors through which the calling and the called subscribers are interconnected.

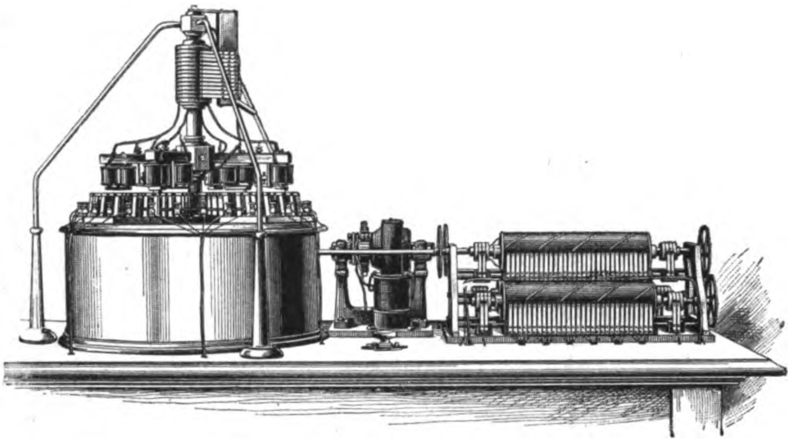


FIG. 2.—CIRCUIT SELECTOR.

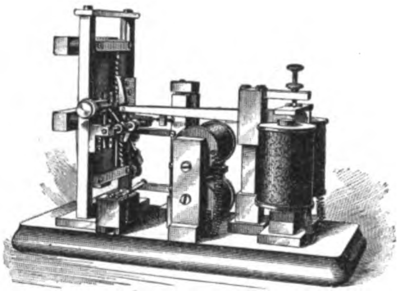
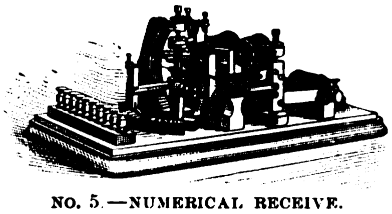


FIG. 3.—PROGRESSIVE SWITCH—FIRST VIEW.


NO. 5.—NUMERICAL RECEIVE.

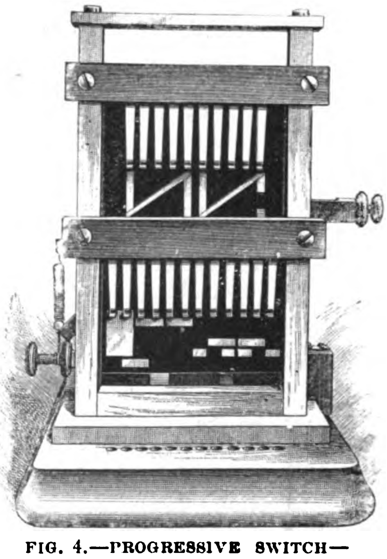


FIG. 4.—PROGRESSIVE SWITCH—SECOND VIEW.

These divisions of the exchange with the exception of the connector are held for intervals varying from one to twelve seconds. As conversation is held through the connector it has the largest percentage proportions, ten per cent being the maximum. The other portions of the apparatus revert to common use directly they have served their independent functions. Those parts of the apparatus that are in use only a few seconds at a time are fewer in number than those in use for longer periods of time. In order that no incoming signal may be lost through an abnormal rise of the call rate, a plurality of signal receiving mechanisms is provided, the number of such mechanisms being in proportion to the number of calls likely to arrive simultaneously. In order that economy may be practiced in all divisions of the system, the signal receiving mechanism is given a power of storing a call for a limited time, the effect of this being that, should a call arrive during a busy hour when the system is fully in use, the call will be stored for a few seconds, long enough to allow some part of the system to fall into disuse and thus to enable the stored call to be operative. By increasing the connecting line from 12 to 18 second, a gain of fifty per cent, in the capacity of the exchange is obtained without any additional mechanism.

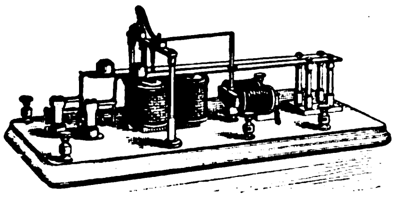


FIG. 6.—NUMERICAL SEPARATOR.

The circuit selector, which is illustrated in the accompanying cut, consists primarily of a series of metallic conducting rings, insulated from each other and held concentrically on the same place. Around each ring is arranged a series of armature headed plungers. These plungers are normally electrically disconnected from the conducting ring, but are adapted to be moved into engagement with the said ring under the influence of electro-magnets carried by revolving arms, each ring of plungers lying in the path of one of these electro-magnets. Each conducting ring represents a distinct percentage division and each controls access to the mechanism of its division. The plungers are terminals of branch conductors from each telephone line and they serve as connectors for establishing a circuit from a signaling telephone to the signal receiving mechanism of the division seized and held for the time being by the signaling telephone. The branch conductors referred to may be connected at will to any one of the conducting rings through the instrumentality of the plunger and the controlling electro magnet. It will be understood that one electro magnet controls one ring of plungers and is governed by an auxiliary mechanism. This consists of one or more revolving cylinders carrying oblique contact strips. These strips are insulated from each other and each strip has electrical connection through a commutator, with its corresponding electro magnet revolving over its appropriate ring of plungers.

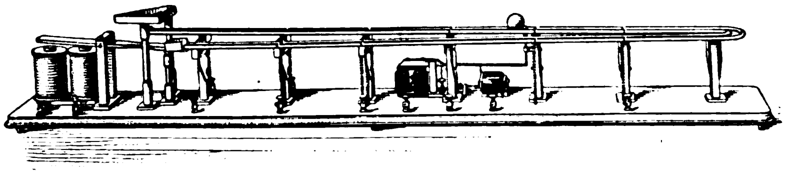


FIG. 8.—SIGNALING TRACK.

Held against the revolving selector cylinder is a series of contact brushes representing terminals of branch conductors, adapted to complete a circuit through the selector under certain conditions to be described later. The cylinder and the revolving arms carrying the plunger-selecting electro magnets are geared together and are revolved by a constantly operating electric motor. There are as many oblique strips on the cylinder as there are sets of conducting rings and plungers. The whole action of the preliminary impulse already referred to is to raise the plunger of the signaling line into electrical connection with some one of the conducting rings. As soon as this is done the circuit is so changed that no other signaling telephone can obtain connection. Should there be another telephone signaling, the impulse will be retained during one revolution of the cylinder or until an unused strip is reached.

The circuit selector controls a group of instruments among which is the progressive switch, two views of which are shown. At the same time a percentage division is seized the impulse also seizes a progressive switch. The portion of the circuit selector soon reverts to common use, but the switch is held until the connection is established. By the action of the switch the signaling line is isolated so that it cannot be interfered with. The impulses that follow one after another are registered by the receivers, and as soon as they are registered, the switch moves forward another degree. In this position the switch is connected to one of the signaling tracks. A constantly operating alternating current generator is put in circuit with the signaling line, through the signaling track and progressive switch for the purpose of ringing the call bell at the outlying station. The progressive switch is then stepped forward another degree, leaving the connecting lines in condition for telephonic communication. The switch is restored to normal conditions. The progressive switches work in pairs, two being seized. One as soon as the registration has been effected of the number for the signaled subscriber which puts his telephone in connection for receiving a call bell signal. It is then automatically instrumental in establishing a talking circuit through an apparatus designated the connector. The circuits are so arranged that when a call goes in if that telephone is busy no progressive switches can be individualized to the use of the busy line.

The numerical receiver registers the signaling impulses as they arrive at the station. They are assembled in percentage groups, the number of receivers in a group depending on the number of lines in a system. In a system of not more than 99 lines, two numerical receivers are required in each percentage group. In a system of not more than 999 lines, three receivers form a group and so on. In a three numeral place system one receiver of a group registers hundreds, another tens and the remaining receiver in that group registers units. If a number called is indicated by a number of one place but one receiver is used, the others remaining unaffected. The receiver is a step by step apparatus of special construction for recording the impulses as received. The various series of impulses are distributed to the proper receivers by what is termed a numerical separator. One of these instruments is included in series with each group of numerical receivers. It consists of a controlling electro magnet having two vibrating reed armatures. The reeds are adapted to be put into vibration for a predetermined length of time on the closure of a circuit through the controling electro magnet. These reeds have different vibratory periods. After being put into vibration by the first series of impulses, the shorter reed first comes to a position of rest and closes a circuit for switching the succeeding series of impulses through the numerical receivers sequentially. The others follow and as the last comes to rest it closes a shunt circuit through a releasing device that places the separator in condition for further use.

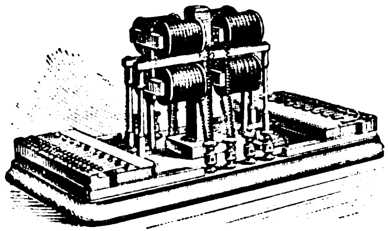


FIG. 7.—NUMERALIZER.

The numeralizer is a compound switch for giving electro mechanical effect to the combined indication of the several numerical receivers constituting a percentage group. It is put into operation after each complete signal has been registered. It combines the fractional circuits controlled by the numerical receiver and selects an integral circuit equal in numecal value to the sum of the combined indications. It is based on the theory of decimal control, aided by a system of transforming circuits, and its method consists in causing one circuit to control ten, a hundred, a thousand or ten thousand by eliminating decimally all values of the thousands, hundreds, tens orders, etc., not indicated by the compound registration of the numerical receivers.

The signaling track consists of an inclined runway, having two copper rails insulated from each other. On one side the rail is continuous and acts as a feeder for supply current. On the other side the rail is broken into sections, having electrical connections with various parts of the percentage apparatus. The arrangement is such that when a circuit closing ball is discharged over the track and makes electrical connection with apparatus connected thereto. Each percentage division of the system includes one signaling track. As soon as a call is registered in any division of the signal receiving apparatus a circuit closing ball is discharged over the track. If the connection is made the electrical current is complete over the entire length of the track and a long ring is given the bells. If the subscriber called is busy, the center position of the track is cut out and two short rings are given as the ball passes over the first and last portions of the track.

The connector consists of a series of conducting strips pluralized on a percentage basis. By a process similar to the selection of the percentage connection for signaling purposes, the plungers of the calling and called subscribers are connected to one of the percentage strips and left in that condition while communication is being held. The other apparatus has all reserted to common use and the connecting strips become free for other users as soon as the conversation is terminated.

While there are many steps and pieces of apparatus in making the connection, yet each follows its predecessor so quickly that not exceeding twelve seconds is consumed in establishing connections. There are other features of this exchange system which have been carefully worked out, but lack of space will not permit the discription to be given here.

The Protection of the Iron Hulls of Vessels.

The iron or steel hulls of vessels on salt water are subject to many destructive elements, against which paints and other compositions fail to protect them. The barnacles on the hulls of ocean vessels destroy the metal and with other marine growths greatly impede the progress of the boats. To guard against these enemies the experiment has been tried of covering the ship's bottom with planking which is then covered with sheet copper. This process was found effective in keeping off the barnacles and preventing the pitting of the metal. But it is a cumbersome method and requires frequent repairs.

Not long since the process of copper plating the iron bottoms of vessels was tried and found successful. The hulls were covered by the electroplating process with copper to a thickness of a twentieth to a sixteenth of an inch. The copper adheres strongly to the iron or steel so that it can be removed only with a chisel. The Scientific American describes the copper plating of the iron hull of the ocean tug Assistance by the company that owns the patent on this process. The tug was placed in dry dock and its hull cleaned. The bath, which is about five feet square, is fastened against the side of hull. It is made water tight and then filled with a strong acid solution which thoroughly cleans the plates. This solution is then drawn off and the plating solution is then placed in the bath. The deposition of the copper requires about four days. A large number of these baths are used which facilitates the work. The tug Assistance is 98 feet long and accommodations will be made for larger vessels if the process in actual sea service proves effective.

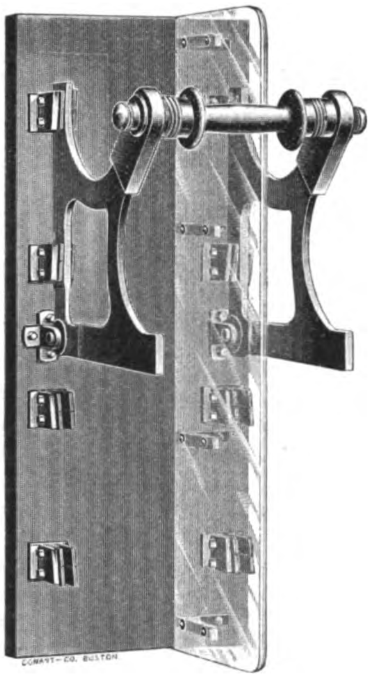
From the Standard Underground Cable Co. has been received a memorial to Frederick E. Degenhardt whose death was announced in the last issue of this journal. The memorial contains a portrait and a sketch of his life. It will be preserved by his many friends as a reminder of the popular and highly esteemed business man, who will long be missed. The company has not yet announced his successor but hopes to do so at an early date.

A New High Potential Switch.

Herewith is illustrated a new type of high potential knife switch designed by C. H. Herrick, E. E., and manufactured by the wellknown firm of W. S. Hill Electric Co., 133 Oliver St., Boston, Mass. The engraving shows one of a group of six switches now in use at the plant of the Narragansett Electric Lighting Co., of Providence, R. I., where they are successfully carrying currents of 400 amperes at 1,000 volts alternating current.

With the advent of large direct connected generators a need for a switch to handle and transfer the heavy currents was felt and Mr. Herrick has successfully met the demand. It will be seen that the switch is very quick break, has a flash guard between its opposite poles, breaks both machines and circuit and has its yoke at a point of absolute safety both to operator and switch. In operation there is no flash when switch is thrown and the slightest possible "wink" in the lamp to which it supplies current.

It will also be seen that our illustration shows a switch adapted for use on the front of switchboards, but designs have been completed for the same type of switch to be placed on the rear of the board. This type is operated by a lever and handle extending through a slot cut in the switchboard. The switch has solid cast copper blades, micanite insulations on yoke and the wellknown Hill reinforced contacts, and will be given a carrying capacity of 50 per cent in excess of its regular duty to allow for all reasonable overloads. It is adapted for all varieties of duty from 110 and 500 volt circuits to those carrying 2,000 volts and over alternating current.



A NEW HIGH POTENTIAL SWITCH.

It is the intention of the Hill company to build these switches in all sizes and types as demand may arise for them and will design this switch to perform any special duty and guarantee results. The Hill company has given it the name of Herrick high potential switch.

As stated above our illustration shows the switch in use on the alternating switchboard designed by Mr. Herrick for the Narragansett Electric Lighting Co., which is capable of handling 50,000 to 100,000 16 candle-power lamps. The design of this board is such that all changes of machines and circuits are made instantly and without the use of plugs, or cables of any sort. The generators can be arranged to run in multiple or independently as desired, provision being make in the design of the board to admit of this feature. This board was also the product of the Hill company's shops and is strikingly handsome, being 22 feet by 6 feet in size and the material Italian marble.

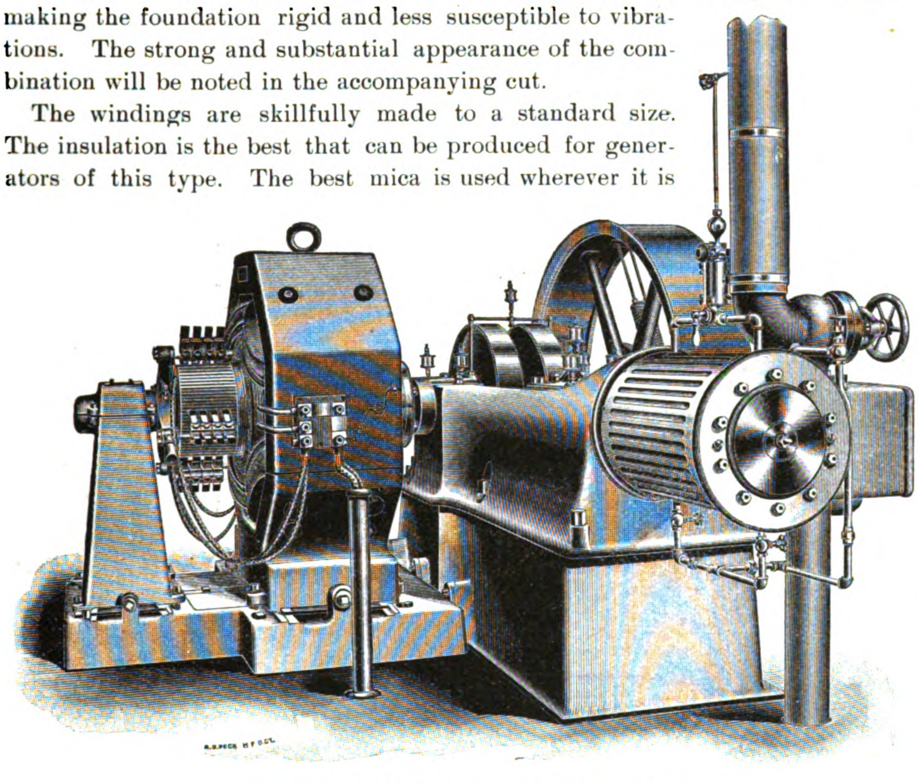
The La Roche Electrical Works, of Philadelphia, made an assignment on January 9th to Mr. J. Franklin Stevens. The company has been engaged in the manufacture of electrical machinery.

The Eddy Direct Connected Generator.

In the accompanying cut is shown a combination which has been use for some time. It consists of a Ball & Wood engine and an Eddy multipolar dynamo direct connected. The successful operation for more than a year of this engine and generator has demonstrated the excellence of the design, and it is now offered by the Eddy Electric Manufacturing Co., of Winsor, Conn., as one of the standard forms of generators. The four cast pole pieces are bolted to the cast iron frame. The field coils are wound on metalic spools, which are held at a distance from the pole pieces to give space for the passage of air and the better ventilation of the fields. This method of construction has been found very advantageous in that the fields are kept cool and greater economy is secured.

The mechanical construction has received careful attention, the effort being made to give mechanical and magnetic strength whenever required. The metal has been well distributed and neat and well-proportioned outlines have been secured. The dynamo base is connected to engine base, making the foundation rigid and less susceptible to vibrations. The strong and substantial appearance of the combination will be noted in the accompanying cut.

The windings are skillfully made to a standard size. The insulation is the best that can be produced for generators of this type. The best mica is used wherever it is possible. The series coils are not wound over the shunt, but are placed in a separate section. The armature is of the iron-clad type. The core is built up of finely laminated iron, the pieces being washers of thin shin sheet iron. This core is mounted on a hollow sleeve, through which the shaft passes. Instead of coils of wire the armature conductors consist of copper bars thoroughly insulated by micanite tubes and laid in slots cut in the armature core. The ends of these bars are fasted by strips in such a way that no two conductors carrying currents of great difference of potential lie near together. The slots in which these copper bars are placed are well insulated with micanite, so that short circuits through the core are almost impossible.



THE EDDY DIRECT CONNECTED GENERATOR.

The commutator is also ventilated and provision is made for air to pass freely through the center. The segments are of hard-drawn copper, insulated by sheet mica, and are held in place by collars. A simple but efficient nut lock has been devised for fastening these collars. It is an easy matter to tighten the commutator strips in place or to remove and replace a strip.

By means of sliding wedges on the base the outboard bearings, as well as the frame, can be aligned. The bearings are of the latest design, self-oiling and of good size. They contain a universal sleeve that greatly simplifies the alignment of the bearings. The generator here shown is of 65 kilowatts capacity. On a test during a ten-hours' run no part reached a temperature exceeding 80 degrees above the atmosphere.

Engineers' Club of St. Louis.

A very interesting and valuable paper was read at the January meeting of the Engineers' Club of St. Louis, by Col. E. D. Meier, on "Chimneys and Chimney Drafts." The capacity of chimneys was one of the main points considered and it was shown that the computations usually made of the capacity of a chimney was below the actual capacity. In these computations it is usually assumed that the chimney gases are of the same specific gravity as the air. This was shown to be incorrect, as when combustion is complete the gases are really a mixture of carbonic acid gas, nitrogen and steam. The proportions will depend on the coal used. As the proper amount of air is seldom admitted there is a greater or less loss. Five well-known varieties of coal had been tested and facts from them were presented in tables. From the computations it was shown how the capacity of a chimney could be increased by raising the temperature of the gases, the result being secured at the expense of efficiency. The changes in height of chimneys was also considered and the effects of different coal on the velocity of gases. The effects of long flues leading to the stack and other constructions were touched upon. A table was presented giving the proper height and areas of chimneys for powers from 75 to 3,000 horse-power. After the paper was read the members present discussed the many points and facts which the paper contained. The table presented by Col. Meier was believed to be conservative, and while it authorized the working of chimneys to larger capacities, it permits in emergencies the chimneys to be worked much beyond the ratings given.

Platinum.

If platinum continues to advance in price, gold will soon be no longer distinguishable as the precious metal, as the continued rise will cause gold to be as cheap in comparison as silver is to gold. If an astute business man had foreseen this rise, and made a "corner" in platinum, he would have done a good stroke of business, for the price of platinum has increased five times during the past three years, and is on the upward grade. The cause of this enormous appreciation is the demand for electrical purposes, and the output of the mines has not kept up with the demand. As electricity is brought home to the public the demand and price will increase, for there are several uses to which platinum is put for which no other metal has yet been found suitable. Notably among these are contact points and leading in wires for electric lamps. Electric bells even now are often fitted with contacts which resemble the real thing, and yet are but a sham. In the other case the coefficient of expansion is the valuable feature. Therefore the problem is to find a metal which will not oxidize on being exposed to the effects of the "break" spark of an inductive circuit, and to get one which will make a tight joint with glass, and has the same coefficient of expansion as that material.--Industries and Iron.

The Cummings & Engelman Underground Trolley and Conduit.

The construction of an underground conduit for electric railways involves many problems which are not easily solved. The climate of our northern cities makes the perfect insulation of the conductors difficult and the service of a rapidly moving car is severe on the conductors and their supports. The method of suspending and insulating the conductors as adopted by many engineers has been found inadequate to the service and the hangers have broken loose and destroyed the insulation. The difficulty also of repairing such breaks causes the stoppage of the system a considerable time.

In the system placed before the public by the Cummings & Engelman Conduit Co., of Detroit, Mich., a construction has been devised radically different from any in use. The method of suspending and insulating the conductors or trolley wires is illustrated in the accompanying cut, Fig. 1. To every third cast iron yoke, which are placed about four feet apart, iron brackets are bolted. These brackets are strong and of such a form as to give a rigid support to the conductors. To these supports angle pieces of insulating material are bolted, on which is fastened the copper strips cut from sheet copper and pressed to V shape. These copper strips are directly opposite each other so that the trolley carriage in passing between them presses one trolley against each conductor.

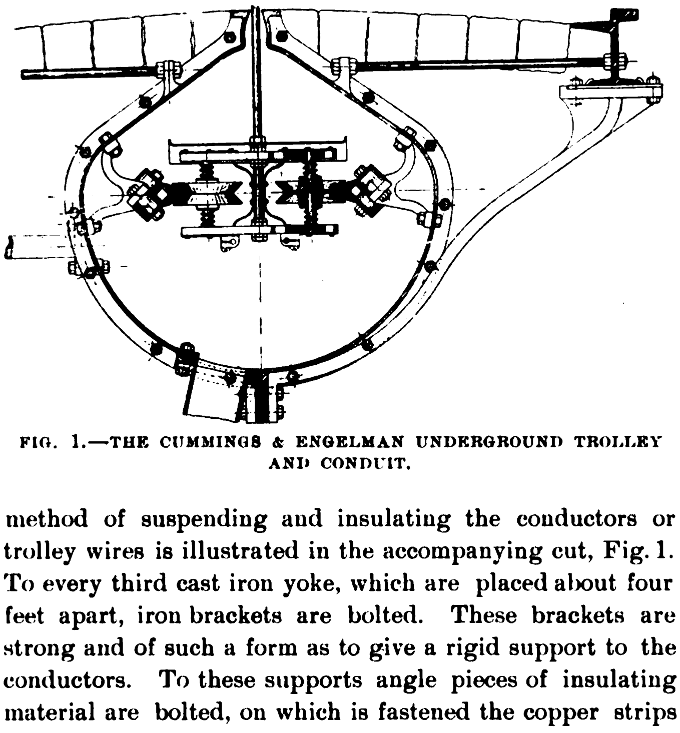


FIG. 1.—THE CUMMINGS & ENGELMAN UNDERGROUND TROLLEY AND CONDUIT.

The trolley carriage is suspended in the conduit by means of two iron tubes through which the conductors pass to the car controller. These tubes pass through a narrow slot which is not wide enough to admit obstructing bodies. Adjustable springs give this carriage a motion in any direction to accomodate it to the inequalities of the track. The trolley wheels are insulated from each other and from the frame by insulating blocks. The lower ends of the trolley wheels are connected to copper plates to which the conductors are attached.

In Fig. 2 is shown a section of conduit for bare conductors for railway feeder, cables and electric light conductors. It has special advantages for railway work. The cut shows but one of many styles of the conduit. This, as shown by cross section, has two ducts. The conduit has an iron exterior enclosing an insulating material which surrounds the ducts. These ducts are themselves insulators for any ordinary currents being constructed of seasoned wood boiled in oil. The method of constructing the joints, which occur every twenty feet, is here illustrated. A departure is made in the old methods of insulations in this system which, however, has been given a sufficient trial to show its efficiency; conduits for conductors carrying as high as three thousand volts have been installed. The Cummings & Engelman Conduit Co. anticipate a busy season in their conduit work. Central station men have investigated the systems laid and are becoming convinced of the economy and success of the system.

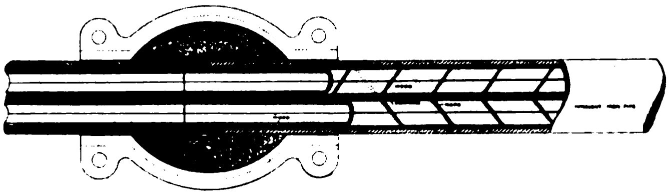


FIG. 2.—THE CUMMINGS & ENGELMAN UNDERGROUND TROLLEY AND CONDUIT.

Champion Safety Catch and Mast Arm Castings.

In the construction of the pole line and the hanging of arc lamps, the many devices which have been put on the market aid greatly in securing a substantial construction. In the accompanying cut is illustrated a safety catch made by the Barber-Koening Mfg. Co., of Hazleton, Pa. By its use the falling of lamp and the opening of the circuit, besides the damage to lamp and danger of striking pedestrians or vehicles, are prevented. Ropes which often appear sound are liable at any time to break, becoming rotten by the weather or cut by ice.

The casting is made of cast iron fitted with a rope pulley and slotted attachment for catching the lugs of safety hook. In order to secure good alignment, the supporting guy wire passes through the casting and is then fastened to it. The safety hook, shown at "A," to the left of cut, is made of malleable iron with projecting lugs for engaging with slots in pulley casing. It is also fitted with a pulley, securing in this manner a double purchase on the rope, so that the lamp may be raised with ease and with half the power.

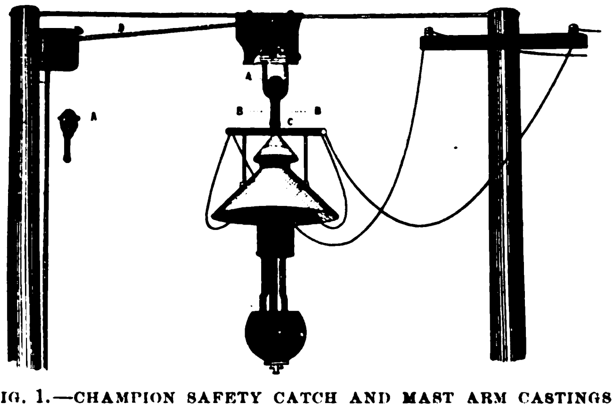


FIG. 1.—CHAMPION SAFETY CATCH AND MAST ARM CASTINGS.

The lamp is suspended so that there is no twisting motion such as winds up and often breaks the lead wires. Such breaks of course render inoperative that circuit and are hard to find as the insulation often holds after the wire has parted. Another set of devices made by the same company which has been found by central station men advantageous in the hanging of arc lamps, is the mast arm castings with a safety catch attachment. This mast arm is the invention of Mr. J. P. Hebendahl, who designed it to meet a demand for a similar article. The material used in the construction of the mast arm is plain wrought iron pipe fitted into malleable iron castings. The rope used in raising and lowering lamp is enclosed in the pipe of the arm where it is fully protected from the weather. The arm also presents a neater appearance on this account. The detail of the mast arm is shown in the accompanying cut. One of the duties of the safety catch is to take all the weight of the lamp when in position and thus prevent the fall of lamp should rope break. The mast arm is attached to pole by a flexible point which enables it to be fastened in any position. The entire arrangement is very simple, strong and easily put up.

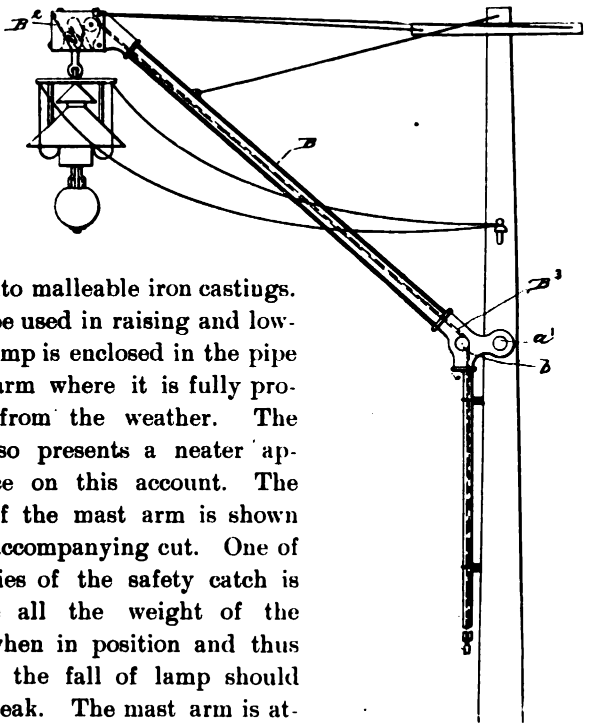


FIG. 2.—CHAMPION SAFETY CATCH AND MAST ARM CASTINGS.

New Transmission System at Pelzer, S. C.

The Pelzer Manufacturing Company, of Pelzer, S. C., has contracted with the General Electric Company for a three-phase electric transmission plant that will be exceptionally large and interesting. At the generating station, three miles from the cotton mills owned by the company, there will be three slow speed generators of 750 kilowatts each directly coupled to water wheels. These dynamos will generate current at a potential of 3,300 volts and the current will be fed directly to the transmission wires at this pressure. The transmission line will consist of eighteen No. 00 wires, this size having been selected in preference to larger wire to reduce the line induction as much as possible under the existing conditions. At one mill will be located a 400 horse-power synchronous motor, receiving current directly from the wires. There be, in addition, more than twenty induction motors in various rooms. Of these fourteen will be 110 horse-power motors and the others will be of various sizes, from 5 to 75 horse-power. In a sub-station will be located nine 160 kilowatt transformers for the motors and for 1,200 incandescent lights for the mills. Two electrically operated blowers of 3 horse-power each will be used for cooling the transformers.

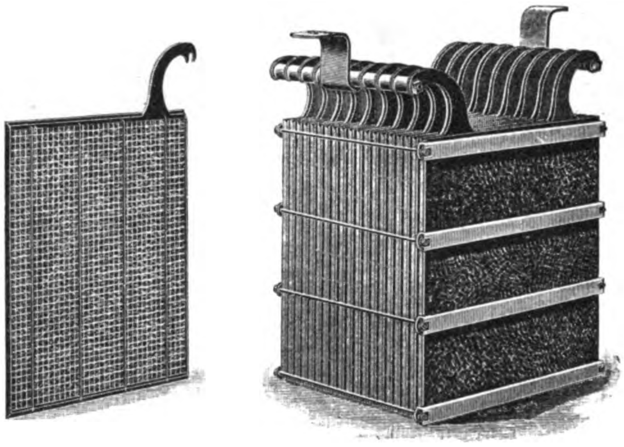
The new exchange of the Ottawa Bell Telephone Company occupies a new three and one-half story building. The switchboard and distributing system is located on the upper floor occupying the entire floor, a room 80 by 32 feet. On the second floor are located the managers offices, battery and instrument store rooms. The tool rooms and storage for supplies are located in the basement. The exchange has a capacity of 3,000 subscribers. All lines enter the building from the underground system. On the overhead lines a ground return is used, but the underground lines have a complete metallic circuit.

The Hess Storage Battery.

In the design of the Hess storage or secondary battery it has been one of the aims of the designer to overcome one of the great difficulties in storage batteries in general—the cost of renewals. One of the distinguishing features of the battery is the permanency of the plates, and in the methods of construction differ greatly from any on the market. These have been designed by Mr. H. K. Hess, of Syracuse, N. Y., and the batteries are manufactured by the Hess Storage Battery Co., of 246 Arch St., Philadelphia.

By the use of a double electrode the plates cannot disintegrate and great freedom is given to the circulation of the electrolyte by the porous nature of the battery elements in the plates. The active material is not pasted upon a single lead plate, exposed directly to the action of the electrolyte, but the plates are in pairs and enclose the active material. The cut, Fig. 1, illustrates one of the pair of plates. These plates are covered with an insulating material after being perforated. The perforations are then filled with a non-conducting material of great porosity, composed of quartz sand, the particles of which are held together by asphalt. The two plates are placed together with the exposed surfaces facing each other, but in such a way that the horizontal lines of one plate are not directly opposite those of the other, but half a space removed, thus reducing the dimensions of the squares and doubling the amount of conducting surface.

It is claimed that by the above method no more metal is required for a double electrode than used in the common type of grid. Between the plates there is space for the introduction of the active material. The materials used in the construction of these plates are easily obtained and the cost of the completed plates is little more than of the ordinary pasted type. In assembling the plates the usual method is followed. The plates are insulated and separated by rubber strips with buttons at intervals of two inches. The method of holding the electrodes together is shown in Fig. 2, soft rubber washers being used to allowed for expansion.



FIGS. 1 AND 2.—THE HESS STORAGE BATTERY.

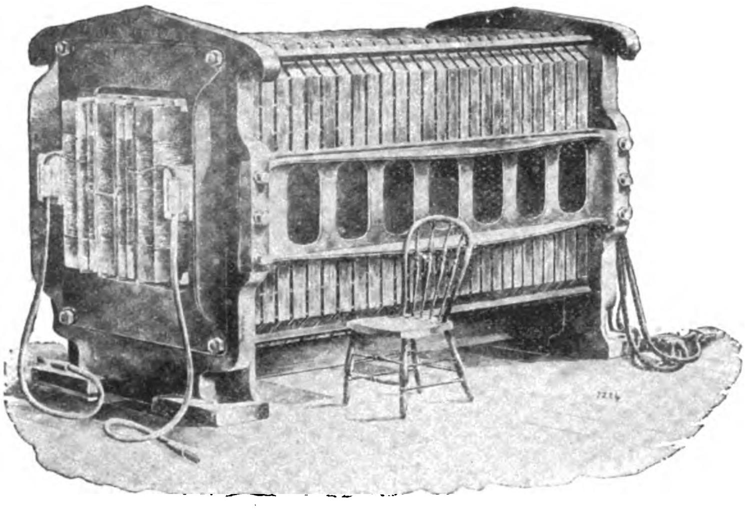
After the assembling of the electrodes they are placed in the cell, which is constructed of wood lined with sheet lead. The electrolyte is then introduced, completely immersing the electrodes, and the cell is then ready for receiving the active material. The active material is introduced by means of a conveyor. This conveyor forces the active material between the plates of each electrode until the space is filled.

This cell is said to be the only storage battery in which there is no directly exposed active material and in which a free liquid space is retained. There are no exposed metallic surfaces not in actual contact with the active material. The special forms of construction which are followed in this battery are decided departures in storage battery manufacture. The result is a battery which is strong and well able to stand the hard service which usually is the cause of the rapid deterioration of storage batteries, heretofore used. The low cost of maintenance, together with first cost of cells, is said to be much less than what has been the experience with such such equipments.

The Air Blast Transformer.

In every city and in many of the large towns there are certain localities where a very large number of lights are used within a comparatively limited area. Such districts can be most efficiently and successfully operated from a transformer sub-station situated within a building at or near the local center of distribution, the current being carried from the sub-station to the consumers over three-wire secondary mains. Outlying groups of lights also can be operated in this way, to great advantage by large transformers connected to the central station by high tension feeders. One of the principal advantages of such methods is that it admits of large transfarmers and they are essentially more efficient than smaller ones.

The principal difficulty met with in transformer work is the matter of temperature. All large transformers to be efficient and economical must be provided with artificial means of cooling.



THE AIR BLAST TRANSFORMER.

Many methods have been from time to time proposed for the artificial cooling of large transformers; such, for example, as the circulation of oil through the transformer and a cooling tank; or the passage of water or other cooling fluid through pipes within the transformer.

Such methods have shown themselves to be complicated and inconvenient. The General Electric Company has however, devised a simple and efficient air blast system, which consists of a transformer having numerous air ducts through which cool air is constantly forced by means of a blower, the temperature being sufficiently reduced by radiation from the wells of the ducts. This system is practically the same as that by which all large dynamos are kept cool, differing only in that we are so fortunate as to have in the dynamo a rotating armature to create the necessary draft, while in the transformer a separate fan has to be used.

By means of the air blast the rise in temperature may be readily kept below 60 degrees Cent., or even lower if required, the 200 kilowatt transformers recently manufactured for the Cataract Construction Co. having a maximum rise of but 35 degrees Cent.

The power required to supply the necessary air blast of course varies with transformer capacity installed, and also with the distance that it is necessary to convey the air from the blower to the transformer. Under ordinary conditions, however, it will not exceed one-half of one per cent of the total capacity of the transformers cooled, and in large substations, it may generally be reduced to one-fourth of one per cent.

A simple method of installing one or more large substation transformers is to place them over a duct beneath the floor having suitable openings beneath each transformer for the air blast which is maintained in the duct by means of a blower driven from any convenient source of power, the duct at the same time serving as a convenient place to locate all wires coming to the transformers. The air passes through the duct upwards through the transformer and may either escape into the surrounding room or may be led away through other ducts as may be found most convenient.

Transformers of the air blast type, are built in the following standard sizes: 40, 65, 75, 100, 150, K. W. Special transformers of intermediate or larger sizes can, however, be furnished almost as promptly as standard apparatus.

Safety Water Column and Gauge Cock.

Some important steam specialties are illustrated in the accompanying cuts which should be found in every boiler room. These goods are manufactured by the Pittsburg Gauge Co., of Pittsburg, Pa. As recent improvements in power generation and present practice calls for higher steam pressures, the use of safety devices is imperative. The excellence of the safety water column here shown will be evident after noting its construction.

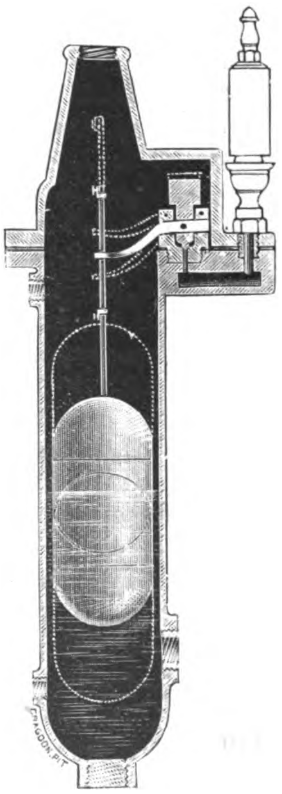


FIG. 1.—WILLIAMS' SAFETY WATER COLUMN.

The Williams safety water column, as shown in the illustration, takes the place of the ordinary water column, being attached in precisely the same manner, having a water gauge and gauge cocks, as the law requires. The interior arrangement is so simple as to be practically indestructible. Inside the body of the column is one seamless copper float, which rises and falls with the solid body of water in the boiler, until either the high or low danger limit is reached, when the knockers act upon the lever which opens the valve and allows the steam to enter the whistle, sounding the alarm for either high or low water.

The distance between the alarm lines can be decreased to suit the requirements, though ordinarily set to blow the whistle at the center of the upper and lower gauge cocks, the lower guage cock being from 2 to 3 inches above the level of the flues or tube line in the boiler, so that when the lower water alarm is sounded, the tubes are still covered with sufficient water to prevent their burning, or the boiler exploding. A low gauge of water can be carried to save fuel and gain steam space and this with absolute safety. Thus, by sounding the alarm for high and low water, it can readily be seen that they prevent carelessness and its usual results—accidents, as well as assuring more power.

The rotary gauge cock shown, is an improvement over the old type which has been in satisfactory use for a large number of years. This is the latest design adopted for stationary boilers. It has all the merits of the old types and satisfies the demand for a positive gauge cock, not dependent entirely on the pressure in the boiler to keep the valve closed. The lever of this cock is made to hold the steam valve to its seat without interfering with the indispensible rotating feature. The spiral being placed before the valve seat, is always protected from collections of sediment, leaving the steam to rotate freely, grinding the seat clean and true. It is impossible for steam to pass the spiral without causing the steam to rotate. These appliances are now being largely used in power plants throughout the country.

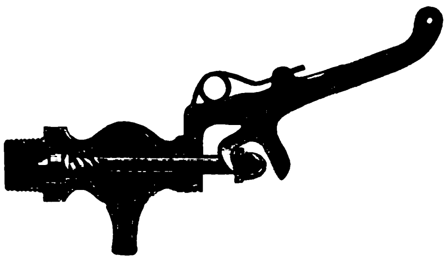


FIG. 2.—WILLIAMS' ROTARY GAUGE COCK.

LEGAL NOTES.

THOMSON-HOUSTON REGULATOR PATENT DECLARED VOID.

In the circuit court of the United States for the northern district of Illinois, Judge Grosscup, at Chicago, delivered last month an opinion in the case of the Thomson-Houston Electric Co. vs. the Western Electric Co. The suit was for an alleged infringement of a patent granted to Thomson and Houston in 1881. The Western Electric Co. was represented by Barton & Brown of Chicago, and the plaintiff by Messrs. Fish, Taylor and Blodget and Offield, Towle & Linthicum. The case had been under way for three years or more, and each side made strong efforts to carry the case. The expert witnesses who testified in the case were some of the most prominent men in the industry. The following is a brief abstract of the opinion.

This is a suit for an infringement of patent No. 238,315 granted to Elihu Thomson and Edwin J. Houston, March 1, 1881, for "current regulator for dynamo electric machines." The object of the invention is to control the operation of a dynamo-electric machine in such a manner that the constant and unvarying strength of current shall be maintained in its circuit, notwithstanding changes of load occurring from variations in the number of lamps or other devices actuated by it. . . .

The claims of the patent are for a combination and are expressed in the following terms:

"1. In a current regulator for a dynamo electric machine, the combination of a device responding to changes in the main or generated current, a shifting commutator for said machine, and mechanism controlled by said responsive device to shift the commutator to those positions where the current taken up by said commutator shall be constant.

"2. In a current regulator for a dynamo-electric machine, an electro-magnetic device acted upon by variations in the main or generated current, an adjustable or shifting commutator for the machine, and mechanism controlled by said electro-magnetic device to adjust the commutator to those positions where the main or generated current taken up by said commutator shall be constant."

Through an inadvertence of the drawings, at variance in that respect with the written description in the patent, the the complainant's device, as drawn, is inoperative. But this corrected, and the device in some other respects slightly modified, the so-called invention is both practical and highly valuable.

The principal defense is that, in view of the prior state of the art, and especially of the invention patented by Thomson and Houston, January 20, 1880, No. 223,659, this so-called invention has been anticipated and the patent is therefore, invalid. . . Patent 223,659 discloses a device almost identical with that of the patent in dispute. . . .

The object here as in the subsequent patent of Thomson and Houston was to obtain a device that would move the brushes backward and forward responsively to the electrical condition that such movements were intended to meet. For this purpose, the patentees employed a mechanical device in every substantial respect like that described in the patent in suit, except that the electro-magnet was put in the short circuit beginning with the forward member of one of the brushes and ending in the main circuit at the rear of the other member of the brush, instead of having been put in the main circuit as in the patent in suit.

It may be admitted that the anti-sparking device is in some respects different from the one in suit. The question is, whether the difference is one of principle and conception or only such difference in use as leaves the uses, nevertheless, analogous. . . .

Now if the uses were analogous, and the principles and devices employed were somewhat different, the sole question remains, whether an electrical mechanic having the knowledge of the art that the public possessed when the so-called invention in suit was conceived could, without invention, have adopted the anti-sparking mechanism to the analogous uses of the patent in suit? . . .

To an electrical mechanic bent upon devising a remedy for the inconstancy of the current caused by the putting in and taking out of the lamps and possessed of the knowledge that a shifting of the brushes on the commutator would accomplish this and that such shifting, within very narrow limits at least, could be accomplished automatically by the anti-sparking invention, the sole problem was presented whether, by a like device, an automatic shifting of the brushes through a wider scope, and adapted to the whole current could be effectuated. The mechanical idea and conception, and the principle on which it was based, were all before him. There was required simple experimentation to determine its adaptability to the new purpose. Doubtless such experimentation was difficult and delicate and called into exercise a multitude of different adjustments of the brushes. But, it was all done in the light and along the lines of the earlier devices and of electrical principles well known to the public.

It was, in my mind, an adjustment purely, and not a new conception of either a principle of electricity of a mechanism to carry it out. If there is any mistake in this judgment it is, I think, in putting a higher estimate upon mechanical skill in electrical fields than is applied to other fields, but, I do not see how this can or ought to be avoided. It necessarily requires high skill to be an electrical mechanic at all. Adjustments and adaptations are there every day made use of. To give to each of these the dignity and consequences of inventions would be to tie up permanently this whole useful field to monopoly. No new distinct conception or discovery ought practically to go unrewarded. But it certainly would if its readaptations, by experiment or adjustment to the thousand uses the field of electricity discloses, were to be regarded as patentable improvements. I differ from Judge Colt in this case with reluctance, for I defer to his superior experience and wisdom in the patent field, but I cannot follow him in this case without violating my own sense of judicial responsibilities. The bill will be dismissed.

January Meeting of American Institute of Electrical Engineers.

At the meeting of the American Institute of Electrical Engineers, held at the usual places on Wednesday evening, January 16, a paper was presented by Prof. Alexander Macfarlane, of Ithaca, N. Y., on "The Units of Light and Radiation," and one by Mr. Alton D. Adams, of Boston, on "The Best Metal for Field Magnet Frames." The date of the February meeting has been changed on account of the convention of the National Electric Light Association.

THE ELECTRICAL CATECHISM.

DESIGNED FOR ALL CLASSES OF WORKERS IN THE ELECTRICAL FIELD.

1. *What is electricity?*

Electricity is either a substance or a force. Some scientists believe it to be the same as the ether, an elastic and extremely thin substance that is supposed to exist everywhere, even between the molecules of solids and liquids and through the space between the stars. Other scientists believe that electricity is a force or form of energy similar to light.

2. *What does the word "electricity" mean?*

It comes from a Greek word, *elektron* meaning *amber.* The Greeks at the time of Thales, 600 B. C., knew that when amber was rubbed it would attract bits of paper and straw.

3. *If we do not know what electricity is how can we use it?*

Although the exact nature of electricity is not fully understood, much is known about it. Many laws have been discovered that always hold true. We do not know exactly what gravitation is, and yet we know its laws and how to make use of them.

4. *How many kinds of electricity are there?*

All electricity is probably one and the same. It is sometimes classified according to its motion, as:

(1) Electricity at Rest, or Static Electricity,
(2) Electricity in Motion, or Current Electricity.
(3) Electricity in Rotation, or Magnetism.
(4) Electricity in Vibration, or Radiation.

5. *What is static electricity?*

Static electricity consists of stationary charges, which show themselves by attracting or repelling other bodies.

6. *What is electricity in motion?*

An electric current manifests itself by heating the wire or conductor, by causing a magnetic field around the conductor and by causing chemical changes in a liquid through which it may pass. It is now believed that the electrical energy is not carried through the wire, but through the space around it.

7. *What is electricity in vibration?*

When the current oscillates or vibrates back and forth with extreme rapidity, it takes the form of waves which are similar to waves of light.

8. *Is magnetism a kind of electricity?*

Magnetism is a result of electric currents and under some conditions will produce currents. A common theory is that magnetism is caused by currents of electricity circulating in the molecules or particles of a magnetized substance.

9. *How long has anything been known about magnetism?*

Hoang Ti, a Chinaman, is said to have used a magnet for a compass in 2637 B. C. The Greeks used a magnet or lodestone at the siege of Troy about 1000 B. C.

10. *How long ago was static electricity discovered?*

It is not known. Moses was acquainted with the lightning, and some of the vessels in the tabernacle seem to have been made with a knowledge of electricity. The Temple at Jerusalem was well protected against lightning and was not struck in 1,000 years. A Greek philospher, Thales, about 600 B. C. mentioned that amber (elektron) attracted bits of straw when rubbed. Aristotle in 341 B. C. wrote about electric fishes that paralyzed other animals.

11. *When was current electricity discovered?*

By an Italian named Volta, about a century ago.

12. *When were electric waves discovered?*

Light has been known since the beginning of the world. Joseph Henry, an American, proved in 1842 that the discharge from a leyden jar was oscillatory. It was not until 1867 that an English mathematician, Maxwell, proved mathematically that light and electricity were the same. In 1888 Heinrich Hertz proved by experiment that this was true.

13. *Why did the older text-books give so much attention to static electricity?*

Because more was known about it than about currents and because it was a means of making many attractive experiments.

14. *Is static electricity used in practical work to any great extent?*

It is not used so extensively as currents. It is important in some uses of alternating currents. One of the best methods of measuring alternating pressures is by means of electrostatic instruments.

15. *Why should a practical worker learn about static electricity if it is so little used?*

Static electricity is dangerous in some cases and troublesome in many others, and it is very important to know how to avoid it and how to get rid of it. It may also find some more generally useful application.

16. *In what different ways is static electricity produced?*

By chemical action, by magnetic induction, by heat, by friction, by influence and in some cases by pressure.

ODDS AND ENDS.

The instrument statement of the American Bell Telephone Co., for the year 1894, shows the number of instruments in use at its close to be 583,666, or 12,245 more than were in use one year previous. There were sent out during the year 89,493 instruments or an average of nearly 300 instruments per day.

The Westinghouse Machine Company has secured a tract of land at Brinton, near the new works of the Westinghouse Electric and Mfg. Co., and expect soon to commence the erection of new works. The plans proposed include a main building 610 feet long by 230 feet in width, also blacksmith shop, power-house, etc.

The announcement was recently made that the New York, New Haven and Hartford railroad is preparing to equip two of its short lines with electric power. This is probably the opening of these lines to electric power. The Nantasket Beach and the Warren and Bristol are the lines mentioned as first to be equipped with electric power.

The power station and rolling stock of the Metropolitan Elevated Railroad, Chicago, are fast approaching completion. Twenty-four new coaches have been received from the Pullman works and some of the motor cars have arrived. The rolling stock is said to be as fine as any in use, and will in a few weeks be in operation as the road will soon be opened to the public.

A public trial of the Sullivan adjustable truss hose bridge was recently made at Pittsburg. The breaking out of a fire on any railway line stops immediately traffic on that street and it is for the purpose of clearing the track that this truss has been devised. The lines of hose that would otherwise lie across the tracks are raised a sufficient height to enable the cars to pass under them. In this manner the blockade is removed and the cars make their regular trips.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

XENIA, O.—Mr. J. P. Martin can be addressed regarding the electric light plant to be installed at Mt. Sterling.

RICHMOND, MO.—The subject of a municipal lighting plant is before the public and will be voted on.

NEAPOLIS, VA.—The Neapolis Electric Light Company contemplates disposing of its present 30-light dynamo and getting a larger one. Henry M. Reece is purchasing agent.

PINCKNEYVILLE, ILL.—The Pinckneyville Electric Light Company proposes to increase its power capacity and also to add more arc lamps. H. P. Huntsinger is purchasing agent.

MORELIA, MEX.—Santiago Murray contemplates the addition of another alternating dynamo, a transformer and about 750 lamps.

ARCHIBALD, PA.—The Crescent Electric Company, which recently completed its plant, is in the market for supplies. Charles H. Bone is superintendent.

POINT PLEASANT, N. J.—The South Jersey Street Railway Company contemplates the erection and equipment of a lighting plant. John R. Weeks, 44 Broadway, N. Y., is secretary.

BENICIA, CAL.—The Benicia Electric Light Company will add a new engine and dynamo.

FAIRBURY, NEB.—The Fairbury Electric Light and Power Company will rebuild its station, about March 1st, 1895.

GLASGOW, KY.—The Glasgow Electric Light and Power Company contemplates the addition of 40-arc lamps and 500 incandescent lamps.

DENVER, COLO.—The Phoenix Telephone & Electric Company was incorporated with an authorized capital stock of $750,000. The incorporators include Messrs. Walker and Baker of Denver and several New York parties.

SPRINGFIELD, ILL.—The Capital Electric Company has let contract, and work has been commenced on its new plant. There are to be 300 arc lamps for street lighting. E. A. Wilson is secretary.

ERIE, PA.—The Merchants' & Manufacturers' Electric Light, Heat and Power Company, will add a 1500 light alternating dynamo. Frank P. Kennedy is purchasing agent.

LISBON, IA.—A municipal plant is now in course of construction. W. H. Runkle is manager.

WADSWORTH, O.—The Wadsworth General Electric Company contemplates the construction of a plant.

GEORGETOWN, D. C.—The Potomac Light & Power Company will put up about six miles of line next summer. M. J. O'Donnell is purchasing agent.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

ORANGE, N. J.—The Suburban Traction Company contemplates quite extensive improvement. F. H. Tidman is purchasing agent.

POINT PLEASANT, N. J.—The South Jersey Street Railway Company will extend its line to Lakewood and Bay Head, twelve miles. John R. Weeks, 44 Broadway, N. Y., is secretary.

INDEPENDENCE, IA.—The Independence & Rush Park Street Railroad Company will exchange its generator and engine for those of greater capacity. A. R. Campbell is purchasing agent.

CONWAY, MASS.—The electric railroad at Conway, Mass., has voted to issue bonds to the amount of $25,000 bearing interest at six per cent.

CENTRALIA, KAN.—The Centralia, Seneca & Pawnee Electric Railway Company has been incorporated to establish and maintain an electric railway. The line proposed is to run from Centralia to Seneca.

DOVER, DELAWARE.—A company has been incorporated called the Dover & Milford Electric Railway Company to construct a line from Dover to Milford. The company is capitalized at $500,000.

ST. LOUIS.—The St. Louis & Kirkwood Railroad Company, owns exclusive right of way, 50 feet wide, for 25 miles, over private property. It will construct numerous branch lines connecting with main line. George W. Taussig is secretary. Office, 115 N. 8th St.

SEDALIA, MO.—The Electric Railway, Light & Power Company, contemplates building the Sedalia & Brown Springs Electric Railway, and operating it in connection with its own road. D. C. Metsker is secretary.

WATERPORT, N. Y.—The Waterport Electric Light, Power & Railroad Company has commenced the construction of a railway from Batavia to Lakeside Park, a distance of 45 miles. The Beecher Single Rail System will be used. Address the Equipment Construction Company, Waterport, Orleans county, N. Y.

DUNDEE, ILL.—The Dundee Electric Light Company contemplates building a line from Dundee to Elgin. G. F. Oatman is president.

PEEKSKILL, N. Y.—The Peekskill, State Camp & Mohegan Railroad Company, will commence the construction of its road about the first of April, next. It is proposed to extend the line to Brewsters, N. Y. George M. Bailey is secretary.

Representing the Cotton States and International Exposition.

Messrs. H. T. Edgar, secretary and general manager, and Oscar Turner, purchasing agent of the Georgia Electric Light Company of Atlanta, Ga., will represent the Cotton States and International Exposition at the coming convention at Cleveland, of the National Electric Light Association. They will present the claims of the exposition and extend information regarding exhibits, etc. A separate building, known as the Electricity Building, is being erected for this department. It is the intention of those interested to make this the greatest exposition ever held in America except the World's Columbian Exposition. Messrs. Edgar and Turner will have their headquarters at the Hollenden. After the close of the convention they will make a tour of the northern cities in the interest of the exposition.

Mr. S. G. Booker.

Probably no one is better known in connection with the manufacture of carbon goods than Mr. S. G. Booker, who has been a resident of St. Louis for years. For a long time Mr. Booker was manager of the Fidelity Carbon Company, which some time since discontinued the manufacture of carbon. In the accompanying engraving is presented an excellent likeness of Mr. Booker, which shows that time has dealt lightly with him. When the factory of the Fidelity company was closed, through the personal efforts of Mr. Booker St. Louis capital was interested and the works were purchased by the present Phoenix Carbon Company These works were immediately put in shape, and the company has since been turning out a high grade of electric light carbons, including the "Black Diamond," which became quite popular. This new company was organized and incorporated under the laws of the state of Missouri, with a full paid up capital stock of $100,000. Mr. Booker has conducted the manufacturing department, and the accounting department is in charge of Mr. Henry L. Page, the secretary and treasurer of the company, who is a very pleasant and agreeable acquaintance.

MR. S. G. BOOKER.

To follow the life of Mr. Booker we should have to follow up the manufacture of carbon for electrical purposes. The small beginning when it was started and the rapid growth to its present immense proportions are portions of its history with which he is familiar. In the later enterprise all wish him success.

FINANCIAL.

The past month has been remarkably quiet with all traders in securities. Few events have occurred to affect the prices of stock or bonds. In some cases larger dividends have been declared than were expected and the price has raised accordingly. The reverse has also been true. With these few exceptions little can be said of prices for the month.

American Bell Telephone has not recovered since the drop after the recent patent decision and the cloud surrounding the subscriptions for the new issues of stock. The company must also meet the competition of new companies which have been organized for the purpose of conducting telephone exchanges. What this competition may amount to is not known; subsequent events will determine this.

The General Electric stock has remained very quiet, perhaps awaiting results in several cases regarding which little is as yet known. The company found it necessary to issue a card cautioning the public against believing the many rumors that were floating about regarding the affairs of the company. The works of tne company, both at Schenectady and at Lynn, are busy, and the street railway department has a large amount of work ahead.

Westinghouse Electric seems to be held very closely. Very little activity is at any time noticeable. The business of the company is known to be excellent and its shops are busy. The removal to the Brinton shops has not been entirely effected but is progressing as fast as it is possible and fill the orders on time. One of the generators for the Nigara Falls power house has been shipped and the others will follow shortly.

Name of Company.	Description of Security.	Amount Issued.	Par Value.	Rate Int.	Date Payable.	Closing Jan. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	190
" " "	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co.... ...	Com.	14,000,000	100	....	....	92
Commercial Cable Co	Com.	7,716,000	100	....	....	138
Chicago Edison Co , Chicago....	Com.	3,000,000	....	8	F. Q.	128
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	Q. F.	122
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	109
" " " ..	1st. 1940.	500,000	100	5	A. & O.	100
" " " ..	Regis.	....	100	5	A. & O.	.....
" " Chicago....		2,500,000	....	....	....	.....
" " New York.	Com.	7,938,000	100	....	Q. F.	101
" " "	1st 1910.	2,562,000	100	5	M. & S.	107
" " Phila......	Com.	1,473,000	100	....	....	120
" " "		... .	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	.....
General Electric Company.	Com.	30,457,000	100	....	......	34
" "	Prf'd.	4,251,900	100	....	....	67
" "	Deb. 1922.	10,000,000	100	5	J.-D.	92
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	103
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	92½
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	.....
Thomson-Houston Elec. Co . .	Series D.	120,000	10	...	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	..	....	.....
" " " "	Prf'd.	400,000	100	....	....	.....
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q J.	88
" "	Var. Issues	13,088,000	100	7&5	M. & N.	108
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	32½
" " "	1st Pf. Cum.	3,755,700	50	7	....	50
Electric Railway Securities.						
Brooklyn—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds. 1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
" " " ..	1st Bds. 1909	300,000	100	5	J. & J.	90
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	100
Buffalo—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	57½
" "	Bds. 1931.	5,000,000	100	....	F. & A.	100
Boston—						
West End St. Railway...........	Com.	9,085,000	50	..	J. & J.	47
" "	Prf'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
Louisville—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	37
" "	Prf'd.	1,000,000	100	5	A. & O.	87
" "	1st Bds. 1930	6,000,000	100	....	J. & J.	.....
Newark, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	.... ..	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	93⅜
New York—						
Union Railway Co	Com.	2,000,000	100	....	....	120
" "	Bds.	2,000,000	100	..	....	105
Pittsburgh—						
Duquesne Traction Co........ ...	Com.	3,000,000	50	...	....	29½
" "	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	21
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		38½
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R....	Com.	3,000,000	25	...	......	14
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
Rochester—						
Rochester Railway Company.. .	Com.	5,000,000	100	...	....	38
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
St. Louis—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	105
" "	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban...........	Com.	2,500,000	400	....	.... ..	22½
" "	Bds. 1921.	1,400,000	100	6	F. & A.	90
Union Depot Railway.....	Com.	1,200,000	100	....	....	110
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	101

TRADE PUBLICATIONS.

The Electric Heat Alarm Co. of 145 High St., Boston, Mass., has recently compiled a catalogue of its various automatic devices. The catalogue is nicely gotton up and substantially bound in cloth. It contains not only a description of the different heat and fire alarm systems, but also annunciators and signal systems for hotels, etc. The various parts of the systems are shown, and the reliable and simple character of the system is explained. To the catalogue is append a large number of testimonials from prominent people and companies in support of the efficiency and value of the signal systems.

A pamphlet entitled Leather Belting, by Chas. A. Schieren & Co., contains much interesting information. It contains a number of views of the different stores of the company at various large cities of the United States and also of the extensive tanneries in both the north and the south. The pages are filled with descriptions of the kinds of belting made and the processes of manufacture. These facts are a help to users of belting in that it enables them to select the best grades of belting. The facilities of the company for the manufacture of belting are fully explained and are such as enable them to manufacture the largest belts required as weil as the smaller. Views of many large and celebrated belts are shown and a long list of purchasers of these well-known brands of belting.

The Nutting Electric Co. has recently issued a catalogue of the wax wheel lamp. It contains a description and illustrations of both the completed lamp and its various parts. The operation of the lamp, the effects of changes of temperature and special features are particularly described. A number of auxiliary devices are also illustrated, among which is the automatic resistance regulator and automatic cut-outs. Another lamp manufactured by this company is the Nutting constant potential arc lamp for incandescent circuits. The company manufacture four types of arc lamps, for series arc lighting, for constant potential circuits, for street railway circuits and for alternating circuits. The catalogue also contains comparative tests of arc lamps that are illustrated by the graphic method. These show the remarkable close regulation of the wax wheel lamp.

Graphite as a Lubricant Scientifically and Practically Considered, has just been issued in its third revised edition for 1895, by the Joseph Dixon Co., of Jersey city, N. J. There is nothing that demonstrates the fitness of an article for a certain purpose like the practical tests and continued use of that article. In this pamphlet tests made by well-known engineers and competent experts are shown together with many facts concerning the mining and preparation of graphite for lubricating purposes. Thus it is pointed out that the graphite must be free from grit and the flake of uniform size. The contributions to the contents made by engineers are full of suggestions and ideas regarding the use of lubricants and the care of machinery. These letters come from engineers in almost every kind of power plants, and show a most diversified use of graphite lubricants. These pamphlets are distributed gratuitously and can be had by anyone on application.

Electric bells and specialties are presented in a catalogue issued by the Arnold Electric Company of Chester, Pa. The importance and general use of the electric bell is thus pointed out: The electric bell has become a necessary part of the household, whether it be a simple device for announcing the presence of a person at the front door; the desire of those at the table to call a servant; the elaborate system of annunciators in apartment houses and hotels or the complicated system of burglar alarms for dwellings, banks, etc. The essential features of the electric bell are explained and the desirable qualities in a bell. The process of manufacturing the bells of this company is shown and the extensive line of goods manufactured. Attention is also called to the Geary & Mossop patented specialties made and the line of electrical goods carried. Craig R. Arnold, 308 Walnut St., Philadelphia, is general selling agent.

The new catalogue issued the first of the year by the Dearborn Electric Company, 19 Quincy St., Chicago, is one of the most compact catalogues on file. The aim has been to place in a handy and convenient form illustrated lists of the immense amount of electrical goods and supplies used in the industry, and it has been well accomplished, as the volume is of a handy size for desk or pocket. It is well arranged and thoroughly indexed. The first pages are given to the well-known Bishop white covered insulated wires and cables, and the extensive line of electrical conductors manufactured by the Bishop Gutta Percha Co. A specialty is made of insulated conductors for difficult and arduous service. Cable for subaqueous, submarine and aerial cables are some of the standard goods of this house. Flexible cords and conductors, magnet wires, iron and steel wires together with conduit, and insulated materials are listed in the first pages of the catalogue. A very extensive line of supplies and specialties for all kinds of electrical construction work follows. The line of fixtures and brackets shows a great variety of styles and designs. Electrical instruments of all kinds, central station and electric railway material cover a large number of pages. The company handles almost everything in the electrical line, and customers will find this catalogue of great assistance in ordering goods. It is not as bulky a volume as many similar publications, but contains much more than some catalogues several times its size. It is of just the size a busy man wants. It is well indexed and the desired information is easily found.

Something very neat in the catalogue line has recently been published by the Cummings & Engelman Conduit Company, of Detroit, Mich. It is well designed, printed on heavy book paper, bound in boards and most tastily arranged. The catalogue presents in an excellent manner the underground conduits for bare conductors manufactured by the company. This is a subject to which the engineers of the company have given special attention for several years. All conditions have been fully met and some of the conduits which have been installed have been in use a sufficient time to demonstrate its efficiency and if there were any faults for them to become apparent. The lines followed by this company for securing perfect insulation for underground conductors are quite different from those heretofore followed, and the change from existing practice has required considerable time in its development. The results obtained by these methods are mentioned as lower first cost, decrease in cost of maintenance, and the general excellence of the entire system. The conduits are modified to meet the different kinds of electrical conductors which are in use. Besides the conduits designed for low potential circuits, a special form has been designed for conductors carrying currents of high potential and requiring the most perfect insulation. Junction boxes, connections and fittings for the mains and service lines are illustrated by detail drawings. Conduit is arranged for one, two or any number of conductors and also for heavy cable of every kind. The catalogue also describes the undergound trolley railway systems for street railway lines. This has been developed with the same care that is shown in the conduit systems.

NEW BOOKS.

The Galvanometer; a Series of Lectures. By Edward L. Nichols, professor of physics in Cornell University, New York; 1894. McIlroy & Emmet. 112 pages; paper, $..

The aim of the author has been to bring together in compact form, for the benefit of readers of limited mathematical attainments, the most important features of the theory of the galvanometer, together with some suggestions concerning the methods of using that instrument. The works of the many able investigators in this field have been made use of. Drawings and diagrams have been freely employed where they have been found to aid in the explanation of the text. These lectures were printed as a series of articles in Electric Power and are now reprinted in this compact form.

Proceedings of the International Electrical Congress, held in the City of Chicago, August 21st to 25th, 1893. New York, 1894. The American Institute of Electrical Engineers. 12 West 31st St. Cloth; 490 pages. Price postpaid $3.00.

This volume has been compiled by the American Institute of Electrical Engineers which undertook the work, as no provision had been made during the congress for the publication of its proceedings. The committee having the matter in charge was composed of Messrs. Geo. M. Phelps, A. E. Kennelly and Francis B. Crocker. The care and ability which characterizes the publications of the institute are shown in this volume. Besides the papers, discussions and work of the congress it contains a short and concise history of the congress by T. C. Martin and an excellent engraving of the official delegates to the congress. The whole has been bound in a substantial volume which will be appreciated by a great many who attended the congress as well as the many who did not. Although many of the papers and much of the discussions were published in the electrical papers the compact and complete form in which they here appear will be found most convenient for reference. The distinguished men who were present and took part in this congress and the important subjects discussed makes the volume an interesting and valuable one to all connected with this science and industry.

PERSONAL.

Mr. C. E. Brown, of the Central Electric Company, has again taken up his business duties after his long and serious illness.

Mr. C. A. Benton, of the Sprague-Pratt Electric Elevator Co., was in Chicago for a short time last month on a business trip to the far west.

Mr. Robert E. Perkins has been elected president of the Metropolitan Elevated Railway, Chicago, for the unexpired term of the late John Worthy.

Mr. Edward R. Grier has recently returned from a business trip to the factory of R. Thomas & Sons at East Liverpool, Ohio, whom Grier Brothers represent at Chicago.

Mr. G. A. McKinlock, president of the Central Electric Company, has sufficiently recovered from his recent illness so that he is now able to be in his office once more.

Mr. Joseph W. Marsh, who was recently re-elected vice-president and general manager of the Standard Underground Cable Co., is now entering upon the fourteenth year of his connection with that company. For a greater part ofthis period Mr. Marsh has been general manager.

Mr. Samuel G. Neiler has become associated with the firm of Pierce & Richardson, consulting engineers, Manhattan Building, Chicago. Mr. Neiler has a large acquaintance among the electrical fraternity and was first assistant electrical engineer of the World's Columbian Exposition.

Mr. Henry C. Thom, the new president of the Northwestern Electrical Association, is prominently connected with a number of state and national associations. He is also interested in politics and educational matters. He was actively interested in the organization of the Northwestern Electrical Association and has since been one of its firm supporters.

BUSINESS NOTES.

Mr. W. H. Fleming, 393 Pearl St., New York, announces that he has taken in charge the sales department as well as the manufacture of his woven wire brush.

The Diamond Incandescent Lamp Company, Denver, Colo., has just opened up a Chicago office at 1231 Masonic Temple. The office is in charge of Mr. J. M. McClave.

The Laidlaw-Dunn-Gordon Pump Co., Cincinnati, opened its new plant for a banquet to the delegates of the National Association of Manufacturers last month. Mr. Robert Laidlaw, president of the company, was elected treasurer of the association.

The Bryant Electric Co., Bridgeport, Conn., recently placed on the market an angle receptacle. The standard lines of sockets now manufactured by this company include almost everything used. Many of the new devices greatly simplify the work of wiring.

The Phoenix Glass Co., Pittsburg, whose factory and packing house at Monaca, Pa., were burned the first of the month, has leased a factory which will be in operation in a few days. The company was very fortunate in being able to save a good portion of its moulds.

The Metropolitan Electric Company, Chicago, has just taken the agency for the American Carbon Co's products and will carry a full line of its goods. The company thus adds another high grade specialty to the already long list. The facilities of the company have in several ways been greatly increased since the beginning of the year.

The Electric Appliance Company, 242 Madison St., Chicago, is making a specialty of theatrical lighting specialties and has secured control of a number of these devices which are particularly adapted to theatre work. So important has this part of their business become that the company has found it necessary to issue a special catalogue of this material. "Catalogue of Theatrical Lighting Devices" may be had upon application. Packard lamps and Packard transformers where once used the

Appliance company is sure of a second order. These standard goods have made a reputation that holds through all conditions of service.

Hoadley Brothers, the well-known engineers and owners of the New England Engineering Company,have removed from their former offices in the Monon Bldg.to the fourteenth flour of the Old Colony Bldg., where they have had a magnificent suite of offices fitted up. We wish them a continuance of phenomenal success attending them heretofore in all their undertakings.

Hugo Reisinger, 38 Beaver St., New York, has taken every precaution to protect the interests of his customers. The word "electra" has been registered by him as a trade mark for his high grade and alternating current carbons and every parcel bears a trade mark containing the word "electra." All infringers of this trade mark as applied to electric light carbons will be proceeded against.

The Sprague-Pratt Electric Elevator Company, New York, recently closed, through its general agent, C. A. Benton, a contract for two electric elevators for the Boston Globe. This is a very important contract, in as much as it displaces hydraulic elevators, and was purchased by the Globe company, because it wanted the best service and was convinced that the use of electricity would effect a great saving in operation.

The Bryant Electric Co., Bridgeport, Conn., will distribute through its representatives some souvenirs at the Cleveland convention. These souvenirs are bound in book form and have been given a title, "Tales You Have Told or Heard Before." They were compiled by the Grier Brothers, Chicago representatives of the Bryant company. Its pages will afford a pastime when returning from the convention or at subsequent times.

The Central Electric Company, 173-175 Adams street, Chicago, has furnished recently the iron armored conduits for a number of large installations. The wiring of the Armour residence on Michigan avenue, which was done with iron armored conduit, has just been completed. Okonite wire and interior conduit are two of the standard lines of goods for which the Central company is always headquarters. Large stocks of these goods are always carried and orders are promptly filled.

The Chas. E. Gregory Co , reports a very successful showing for the past year. An annual dividend of 10 per cent has been declared for the year ending February 1. A surplus fund was also created from the earnings of the emergency. Mr. Gregory reports sales during the year of 161 dynamos, 192 motors, and 2,113 arc lamps, besides the sales of the supply department. A handsome pamplet has been issued showing where their dynamos and motors were sold. This pamphlet may be had upon application by any one who desires it.

W. S. Louttit, for a long time well known as assistant contracting agent of the Pullman Company, recently decided to go into business for himself and has opened an office at 50 Dexter Building, Chicago, where he will conduct a general supply business. Among other specialties he has secured the western agency for the railway lamps manufactured by Thos. Smith & Son, of New York, the largest manufacturers of lamps in the United States. Mr. Louttit's many friends will join us in wishing him every success in his new enterprise.

The Consolidated Car-Heating Co., Albany, N. Y., has added considerably to its plant in order to meet the demand for the Pope light, which is interchangeable with the Pintsch now in wide use, and is prepared to manufacture lamps for compressed oil gas and fittings on a large scale The compressed gas plant recently erected shows most excellent results. The company is preserving data in regard to the use and operation of this light, which will be made public when completed. It is expected that this will show some remarkable savings.

The Western Electric Company, Chicago, has just obtained a contract for the complete wiring throughout of the new city hall building at Milwaukee. This building is ten stories in height and is in every way modern in all its appointments. The total number of lights required will be 5,000. The company was represented by Mr. Edw. Ellicott. A contract was also recently closed with the city of Allegheny, Pa., for a plant of 480 arc light capacity. A very bitter fight was made and the Western company being the lowest bidder secured the contract.

The Metropolitan Electric Company, 186-188 Fifth Ave., Chicago, has issued a pocket catalogue of insulators made from hard, vitreous porselain. The body and glaze are both composed of earthy materials. No lead or oxides are used in the glaze as is done in the chinaware. The goods are all fired with natural gas to about four thousand degrees Fahr. They are absolutely non-absorbent, and in this respect combine exceptional insulating qualities. The works are especially designed for the manufacture of porcelain, electric telegraph and telephone supplies. This class of goods received the entire attention of the works. Orders are shipped from the factory or are filled at the warerooms of the company in Chicago.

Ferris Electrical & Mfg. Co.,Cedar Rapids,Iowa, is the name of a new company that will do a general construction business and handle supplies of all kinds. Two of the principal members of the company are Messrs. Robert and Thomas Ferris, who have been connected with the larger manufacturing and supply companies. Mr. Thomas Ferris was for several years connected with the Edison company and later with the sales department of the General Electric Co. Mr. Robert Ferris has been with the T-H. General, Ansonia and until recently with the Central Electric Co. Both are young men of wide experience and they have the best wishes of their many friends for succe

W. S. Edwards Mfg. Co., 21-23 E. Lake St., Chicago, has recently bought out a number of new styles of electroliers, column lights, etc. The new designs are especially striking and are worthy of careful consideration by purchasers. The great variety of goods manufactured by this house gives it a great advantage for the production of new designs. The new catalogue contains much that is new and interesting to dealers. This catalogue is number five and can be had on application.

Mr. Foree Bain, the well-known electrical engineer, especially in the south and west, has opened an office in suite 1657 to 1659 Monadnock Block, Chicago, and extends an invitation to his friends and acquaintances to call upon him. He is making a specialty of designing machinery in which electricity is applied to new uses to hasten and cheapen the process of manufacture in the industrial arts. Having devoted a considerable attention to patent causes, he is meeting with success as an expert. Mr. Bain informs us that he is not connected with any manufacturing company, and therefore his judgment and opinions are unbiased and free from any prejudice that might otherwise exist. He has our best wishes and that of his many friends for his success.

The Western Telephone Construction Company, Chicago, has just closed a contract with the United States government for the equipment of the Interior Department with 115 telephones of the magneto type. This contract was closed after sharp competition in which the leading telephone companies participated and the contract was awarded the Western company after careful tests had been made. The main switch board is located in the patent office and the exchange connects the various bureaus of this department including the patent office, pension office, bureau of education and the National Museum. In addition to this contract the company is building an exchange at Newark, O., of 200 telephones with switchboards, etc. The company has just completed an exchange at Two Rivers, Mich.

The Wallace Electric Company, 307 Dearborn St., Chicago, has recently closed arrangements with the Whittingham Electric Car Heating Co., for the sale in the western states of the Whittingham electric car heater. The heater is so constructed as to present a large amount of radiating surface to the air, which is a most important point. There are two variations of heat, one consuming three amperes which is considered sufficient for ordinary cold weather, and another consuming six amperes which is considered ample for severe weather. With the system of distribution used the heaters may be arranged so as to consume any amount of current the company think advisable. One of these heaters has been installed in the company's office where it may be seen by any who care to investigate the matter. A circular has been issued describing and illustrating the heater, which may be had upon application.

The Ball Engine Co., Erie, Pa, continue to keep their shops well filled with work, and have recently taken some good sized orders. Among recent shipments of electric light engines are the following: Oskaloosa Edison Light Co., Oskaloosa, Iowa. two 175 horse-power direct connected engines; Chesapeake Light & Power Co., Hampton, Va., one 300 and to the Peninsular Electric Light Co., Detroit, Mich., one 150 horse-power cross compound; Dunkirk Electric Light Co., Dunkirk, Ind., one 100 horse-power tandem compound; Barnesville Gas & Elec. Lt. Co., Barnesville, Ohio, one 80 horse-power, Washington Electric Light Plant, Washington, Mo., one 50, Norfolk Navy Yard, Portsmouth, Va., one 80, Yngo Soledad Plantation, Guantanamo, Cuba, one 35, Canon City Elec. Light & Power Co., Canon City, Col., one 100, Sweetwater Mill Co., Sweetwater, Tenn., one 25, Crook, Horner & Co., Baltimore, Md., one 125 and L. M. Rumsey Mfg. Co.. St. Louis, Mo., one 60 horse-power single cylinder engines.

The Standard Underground Cable Co. held its annual meeting on Tuesday, January 22, 1895. The old board of directors, which was composed of George Westinghouse, jr., Mark W. Watson, J. W. Dalzell, James H. Willock, John B. Jackson, George B. Hill, John Moorhead, jr., Robert Pitcairn and Joseph W. Marsh, was re-elected. The business of the year amounted to $963,464, which was an increase over the previous year of $101,551. The company paid out of the net profits of the year four quarterly dividends of one and one-half per cent, amounting to $60,000. The company has a surplus of $531,000 over its paid-up capital stock of $1,000,000. It has now unfilled orders of $58,000, and contracts with two companies which give promise of $250,000 worth of business during the year. During the past few years the company has furnished large quantities of underground feeder cables for street railways. During the past three years it has furnished the Philadelphia Traction Co. to the amount of $700,000. Its business has increased to such an extent that it was necessary for the company to erect during the past year a new building which will soon be ready for use. The company will also commence the erection this spring of a four-story building at its present plant.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

W. H. McKINLOCK, President. **W. C. McKINLOCK, Secretary.**

METROPOLITAN ELECTRIC COMPANY,

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WIRES, CABLES,
ROYAL TRANSFORMERS,
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COMPOUND ARMATURE VARNISH TAPE,
WEATHER-PROOF WIRE,
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HIGH INSULATION--LOW COST.

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"IDEAL"
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CABLES

Insulation tests on this wire show 22 meghoms per mile after four days' immersion in water.

It will not deteriorate by long use nor oxidize the copper.

WRITE FOR SAMPLES AND PRICES.

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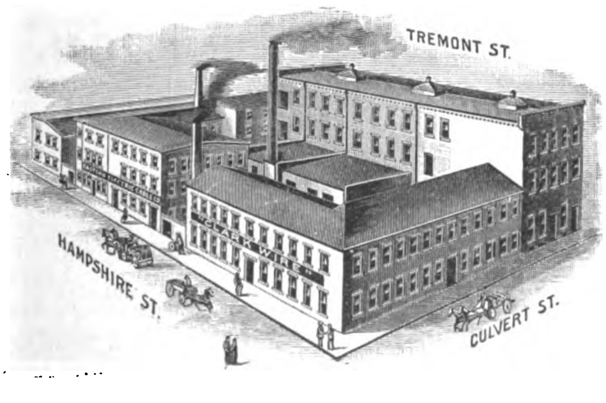
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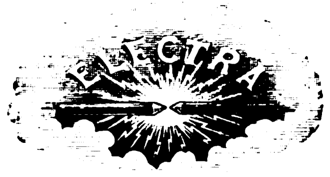

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Cincinnati, O., 264 West Fourth Street.
Chicago, Ill., Monadnock Building.
Columbus, O., 12½ No. High Street.
Detroit, Mich., 13 Rowland St.
Omaha, Neb., 309 South Street.
Kansas City, Mo., New York Life Building.

St. Louis, Mo., Wainwright Building.
Dallas, Texas, Corner Elm and Griffin Streets.
Denver, Colo., 505 Sixteenth Street.
San Francisco, Cal., 15 First Street.
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ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. March, 1895. NEW YORK. No. 3.

A Compact Isolated Lighting Plant.

Electric lights were at first almost entirely fed from central stations; at the present time a very large portion is supplied by isolated plants. A good portion of the large office buildings, manufacturing establishments, hotels, etc., have now electric lighting plants as part of their equipment. The number would be largely increased in the buildings of our cities were it not for the lack of space which such a plant would occupy. Nearly all have sufficient boiler equipment, and the installation of a lighting plant would involve but the addition of the engine and dynamo.

In the accompanying engraving is shown an isolated plant of 400 lights' capacity, which is very compact, requiring but a small corner in the engine room. The engine and dynamo are direct connected and are mounted on one base. It illustrates one of the latest combinations and occupies so little space in proportion to its capacity that plants of this kind can be installed in many places where lack of room has prevented the installation of plants heretofore. The care that such a plant requires is small, and the force of attendants would not have to be increased. The combination is also well adopted for central stations. The plant as here shown operates the lights in a factory.

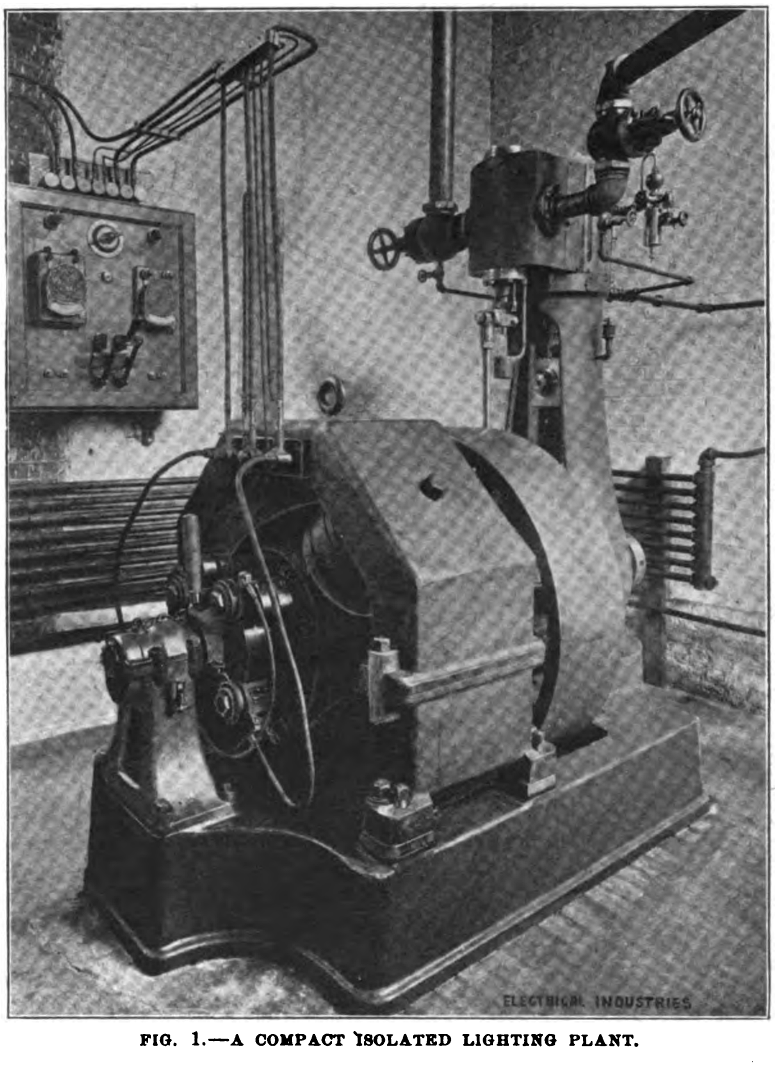


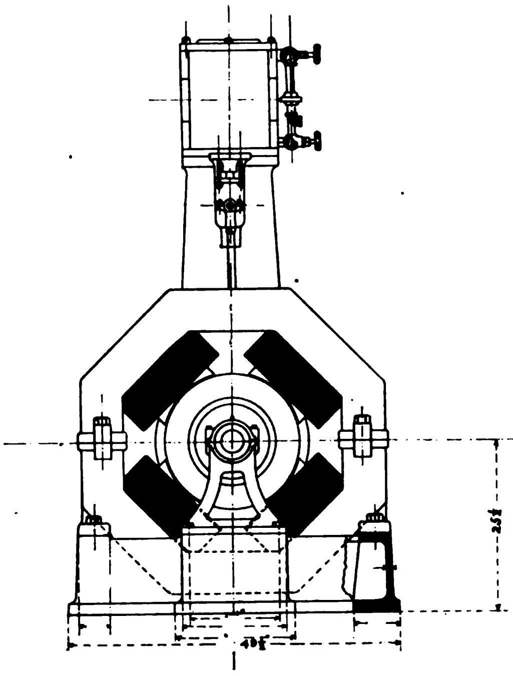
FIG. 1.—A COMPACT ISOLATED LIGHTING PLANT.

The switchboard is also small and compact, and the instruments in use are all that are necessary for regulating and measuring the current. A complete description of this combination will be of interest. The engine is made by the Racine Hardware Co., and has a cylinder 9 by 9 inches, running at 130 pounds boiler pressure. The dynamo is built by the Western Electric Co., and is of a four pole type. The frame is made of cast iron, split at the center so that the top can be lifted off to give ready access to the armature. The pole pieces are of wrought iron bolted to this cast iron frame.

The field coils are wound upon brass bobbins which are thoroughly insolated and are separated from the cores and from the frame by a large ventilating space which insures very cool running. The armature is of the iron clad type and is ventilated by holes passing through the armature parallel with the shaft. These holes communicate with radial air spaces between the core discs so that there is a free path for the passage of air in at the center of the armature and out through the radial holes which are distributed through the entire body of the core. The winding consists of copper bars imbedded in the slots of the core. The method of construction is to insert an insulating tube, which is closed at the top of the slot, in the holes in the core, then the bars are placed in position and driven firmly into place by wooden wedges between the bars. The winding at the end of the armature is formed by stampings of sheet copper which are bent into spiral form and insulated by being run through a braiding machine. These spiral stampings are held at the bottom by screw clamps and at the periphery by being soldered to the armature bars and thus each connector is held in place independently of the others. The winding is so arranged that there is good ventilation space between the spirals so that it is impossible for the winding to overheat, even on extreme overload. Both the spirals and the bars are tinned before being put in place so that a very perfect soldered joint is obtained. The end of the connector is looped and riveted back on itself and this loop surrounds the armature bar so that in case the solder should give out for any reason there is still a good mechanical joint.

The armature and commutator are built upon a sleeve which is bored to fit the engine shaft so that the armatures can be interchanged. The machines are all provided with carbon brushes and the commutators and brushes are exceptionally large for the capacity of the machine. The design of the machine is such that the brushes can be placed in a fixed position and the load varied from zero to 25 per cent overload without the slightest sparking.

The outboard bearing is of the usual self-oiling, self-aligning type. The 220 and 500 volt machines have an iron clad armature wound with wire bars which are separated by carrying rings at the end so that the same system of ventilation is secured with this winding as with the spiral connectors. These machines will run continuously for twenty-four hours on full load without heating over 60 degrees in the armature and field coils and 80 degrees in the commutator.



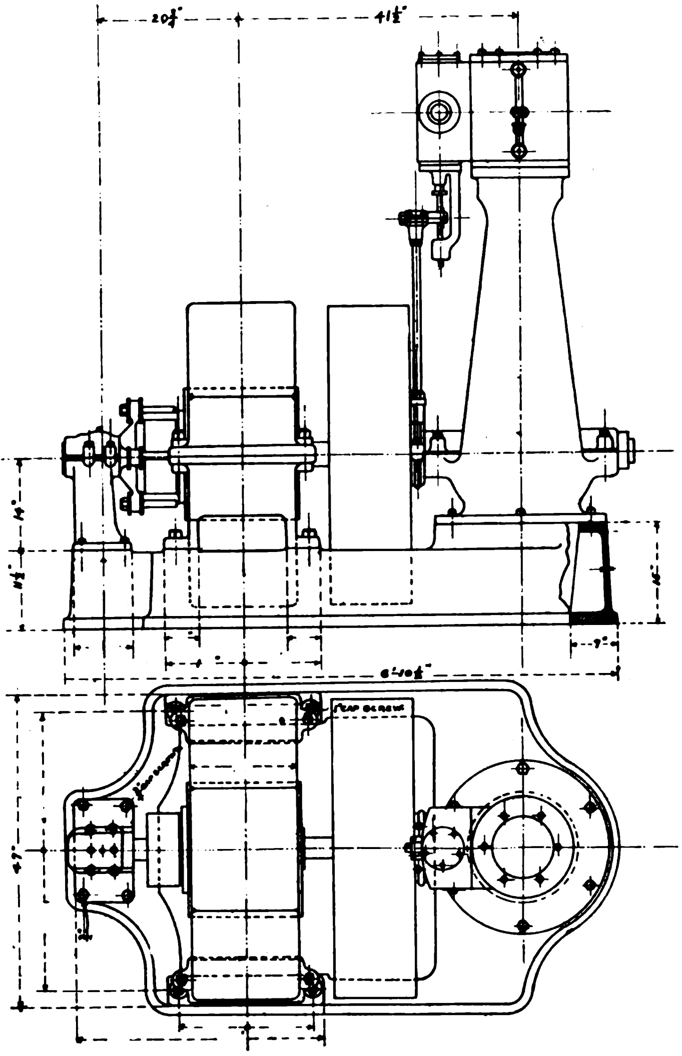


FIG. 2.—A COMPACT ISOLATED LIGHTING PLANT.

This combination has shown good efficiency in very hard service. It has frequently been run for short periods with a 50 per cent over load and for several hours at a time carry an over load of 30 per cent. It seems especially adapted for lighting plants, regulating easily between light and heavy loads.

The Electro-Zincing Heavy Iron Work.

Since the new process was introduced of plating heavy iron work with zinc, known as the Cowper-Coles system, tests have shown the excellence of the process. This process will supersede the galvanizing process so extensively used. The London Electrical Review describes a plant recently installed by Maudsley, Sons & Field, which was designed especially for plating tubes for water tube boilers. The plant has a capacity of 3,000 amperes at 5 volts. In this plant in place of zinc anodes the zinc is in a very fine state of division suspended in the electrolyte. This method has been found a great improvement over the former methods. The same article also describes and illustrates the plant of the Thames Iron Works and Shipbuilding Co., whose tanks have a capacity of 14,000 gallons. This plant is used for galvanizing the frames and angles of torpedo boat destroyers and similar material. In these plants in which so large currents are used the system of distribution involves the use of extremely heavy conductors and all connections of a relative size. These plants are working very satisfactorily, and many of the difficulties which have heretofore been experienced are overcome easily in the process invented by Mr. Cowper-Coles.

The Electrical Lighting of Carriages.

The electric lighting of carriages has not received the attention in America which has been given to it by the European manufacturers and engineers, where private carriages lighted by electric lights are not uncommon. A number of business houses have for purposes of advertising had their wagons lighted with electric lamps from storage batteries, but with this exception little has been done in America. The advance sheets of the consular reports contain an article by C. W. Chancellor, consul at Havre on this subject. In this article he says electrically-lighted carriages have been extensively patronized by the wealthy classes in Paris for the past five years, but little has been done until recently in London. The Prince of Wales was the first to adopt it there, and now the German Emperor has his carriages in Berlin lighted by electricity, not only on the outside but within, all of the lights being supplied by accumulators carried in the vehicle. The consul calls attention to several advantages of this method of light. First, the distinctly practical usefulness; and the second, that of increasing the brightness and cheerfulness of the streets; and further, it has been ascertained the more the public conveyances are made attractive the greater will be their traffic. The expense of electrical lamps when once installed is very small, and the space occupied by the storage batteries is not large.

The Alternating Current; Its Generation and Distribution.—V.

BY PROF. GEORGE D. SHEPARDSON.

The "magneto" described in the last paper is suitable only for small currents. It is used very extensively in telephone service as a calling device for ringing bells. The magneto with bell is a convenient device for testing purposes. By connecting the terminals of the magneto to any two points supposed to be parts of the same circuit, and turning the crank vigorously, the bell will ring if the two points are electrically connected. This method of testing is also applicable for detecting "crosses," "breaks" and "grounds". The bell itself should be tested frequently by touching its terminals together and ringing.

Magnetos become weak with use and will not ring through so high resistance as when new. This is because the magnets lose part of their magnetism. Since the E.M.F. developed by the armature equals the rate of cutting lines of force, it follows that the faster the crank is turned, the higher will be the voltage of the magneto. It will therefore ring through a higher resistance, if it is turned morer apidly.

By the loudness of the ringing one can obtain a rough estimate of the resistance of a circuit. The force with which the hammer strikes the bells depends upon the quantity of current passing through the bell magnets, which is the same as the current through the rest of the circuit. By Ohm's law, the current equals the voltage divided by the resistance, or impedance, of the circuit. Therefore, with the magneto turning at a constant speed, so as to keep the voltage constant, the bells ring louder as the resistance is less. This test simply shows whether the resistance is high or low. The person who is turning the crank will also notice that the crank turns harder as the resistance is less. This is for the obvious reason that with a given voltage, the work done—the electrical energy given out by the magneto—is proportional to the current flowing through the circuit. If the resistance between the two points tested, exceeds a certain amount (1,000 to 50,000 ohms, varying with different machines), the bell will not ring.

One may detect a connection, even if the resistance exceeds the ringing limit, by making use of his own sense of touch. Connect one terminal of the magneto to one of the points to be tested. Take the other magneto terminal between two fingers, which should be clean or moistened, and place the back of the hand against the other point to be tested. The hand thus becomes part of the circuit and will notify the owner if even a very small current passes when the magneto crank is rotated. This method increases the sensitiveness of the magneto five or ten times. If the hand in the circuit belongs to the same person who turns the crank, he should be careful not to let the other hand touch the metallic portion of the crank—for obvious reasons.

While the magneto is very convenient for testing purposes, its field is limited, because it sometimes gives false indications. It will not ring if the resistance between the two points exceeds a certain amount, as already stated. On the other hand, the bell will sometimes ring although the resistance of the circuit is millions of ohms. If the magneto is connected to the two wires of a flexible lamp cord, consisting of two cables twisted together, the magneto will ring, if the cord is several hundred feet long, although the wires are separated at the further end and the insulation resistance between them is several hundred megohms. (A *meg-ohm* is a million ohms.) A good magneto will ring loudly if connected between the ground and a conductor in an underground cable, although the insulation resistance is many megohms. Similarly, by testing between the field magnet coils and the frame of a large dynamo, one will feel a decided shock, when his hand is in the circuit as suggested above. By connecting the magneto to the terminals of an adjustable condenser, it is found that the bell rings when the capacity of the condenser is increased beyond a certain amount.

The fact that a magneto may ring, although the circuit is what would ordinarily be called "open," is explained by the action of the condenser. When two conducting surfaces, which are insulated from one another, are connected to the terminals of a battery, dynamo, or any other source of difference of potential or voltage, the two surfaces become charged until they have the same difference of potential as the battery. The combination of the two conducting surfaces and the insulation between them is called a condenser. It requires a definite *quantity* of electricity to charge the two surfaces to this difference of potential. The quantity of electricity required to charge the two surfaces, so that their difference of potential is one volt, is called the *capacity* of the condenser. The capacity of a given condenser depends upon the size of the plates, their distance apart and the nature of the insulator, or *di-electric*, between them. The larger the surfaces and the shorter the distance between them, the greater is the capacity.

While the surfaces of the condenser are being charged, a current is flowing between each surface and the battery or dynamo. The strength of the current depends upon the voltage and upon the capacity of the condenser. When the condenser is charged from a battery or other source of constant potential, the current into and out of the condenser is greatest at the instant when the contact is first made and it quickly falls off to nothing.

If, however, the voltage of the dynamo is continually changing, current will flow in and out from the condenser. If the source of potential is alternating like a magneto or alternator, each surface of the condenser will become alternately charged positively and negatively. The result is that an alternating current flows in each of the wires connecting the condenser with the alternator. If, then, a magneto with a bell is connected to a condenser of sufficient capacity, the bell will ring. In the case of the lamp cord, the two wires or cables furnish the two surfaces and, if the cord is long enough, the capacity will become great enough so that the current from the magneto will ring the bell. Likewise in the underground line, the wire forms one surface and the surrounding earth forms another.

The capacity between neighboring wires in a cable, or between the wires and the lead cable covering or the earth is a source of trouble in the working of telephone cables and submarine telegraph cables. In constructing such cables, great care is taken to secure a dielectric with small *specific inductive capacity* so as to reduce the capacity of the cable. The capacity of neighboring wires in telephone cables, or even in overhead wires on long lines, is one of the principal causes of the "cross-talk" between different telephone lines. The unavoidable capacity of underground and submarine wires is the reason why at present it is impossible to telephone across the ocean.

The Belt Line tunnel at Baltimore is to be lighted by incandescent lamps, of which it will require 960. These lamps are to be attached to the sides of the tunnel, and will be supplied with current from the same power house that furnishes current for the electric locomotives.

The Electric Railway System of Binghamton, N. Y.

The electric railways of our cities present much that is interesting not only to engineers in whatever line, but to the student and the public in general. This form of traction, although it is ten years since the first system was installed, is still new, and to many minds is full of mystery. It is not this feature alone that is interesting, but the facilities afforded by this most modern system for quick transportation, the comfort that is given passengers and the regularity and perfectness with which the system is operated. The many details of the electric system, involving in the beginning much study, have gradually been brought to a high standard.

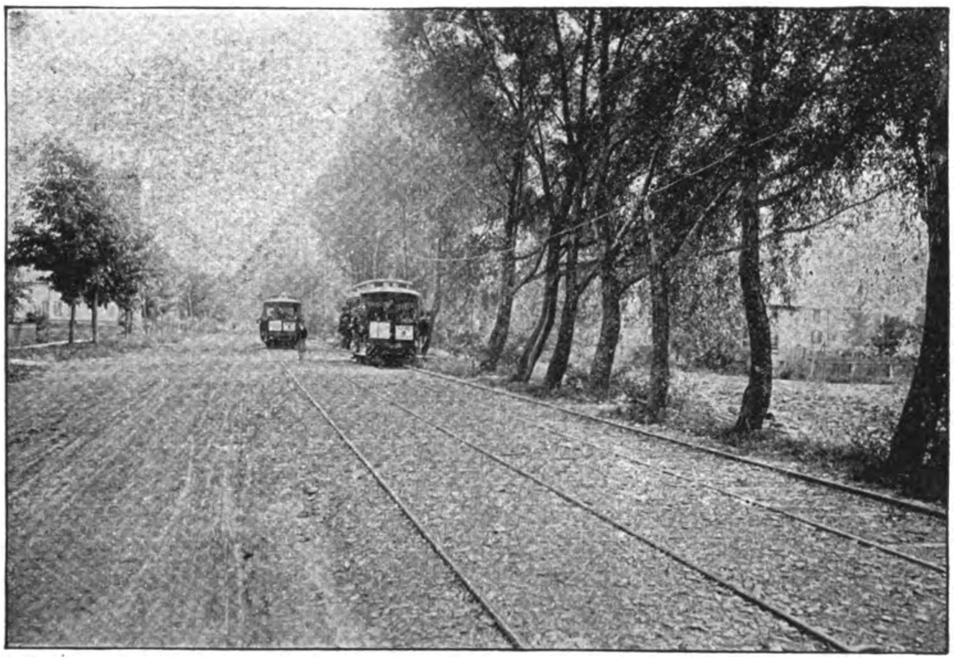


FIG. 1.—THE ELECTRIC RAILWAY SYSTEM OF BINGHAMTON, N. Y.—PARK AVE.

The first electric railway constructed in the state of New York was built at Binghamton by the Washington Street and State Asylum Railroad Company, a road that now forms a part of the consolidated system. The consolidated system is owned and operated by the Binghamton Railroad Company, which was chartered in 1892. The officers of the company are: President, G. T. Rogers; vice-president, J. B. Landfield; secretary, C. O. Root; treasurer, J. B. Rogers; and general manager, J. P. E. Clark. Formerly the street railways of Binghamton were operated by some nine separate companies, and as might be expected, the service was neither satisfactory to the public nor to the companies. The organization of the present company and the development of the present system is due to the president and general manager. The undertaking at the outset was a most difficult one, and especially from a financial point of view, but it was well carried out, and the present quotations of stock and bonds is a sufficient indication of the success of the movement.

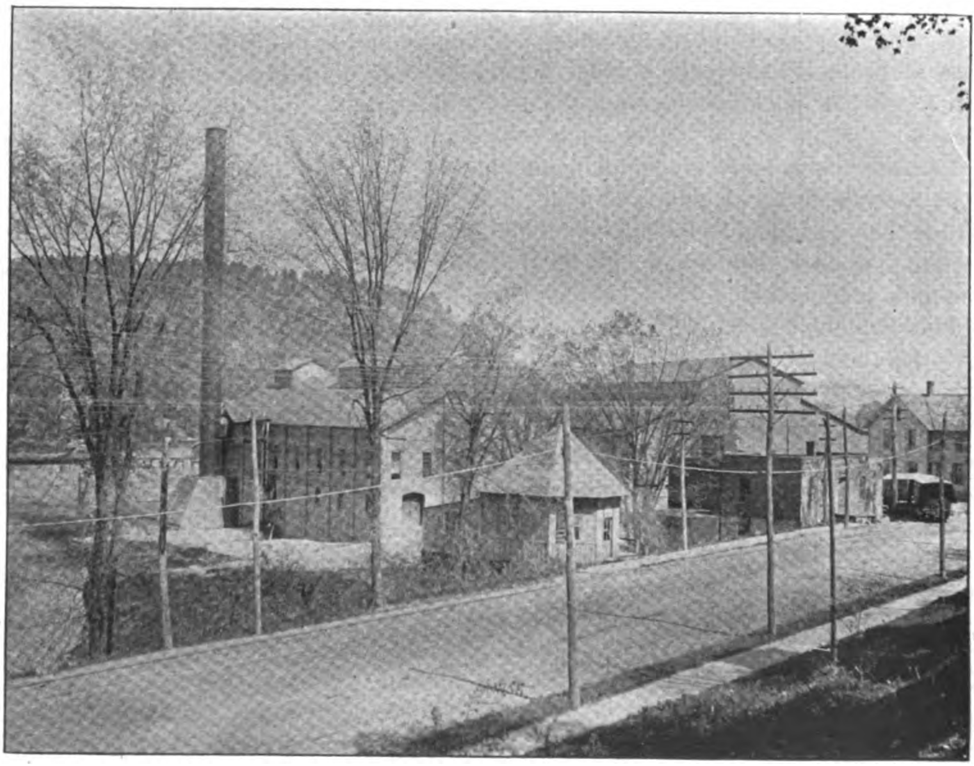


FIG. 2.—THE ELECTRIC RAILWAY SYSTEM OF BINGHAMTON, N. Y.—POWER HOUSE.

In Fig. 2 is shown a view of the exterior of the power station, officers, etc., which are located on State street, near the Chenango river. The building is of fire proof construction, the walls being of brick and the roof slate, supported on iron trusses. The building is 65 by 128 feet. An interior of the station is shown in Fig. 3. The equipment of the power station consists of one cross compound and two tandem compound Ball & Wood engines, whichdrive two 80-kilowatt bipolar generators and two 100-kilowatt General Electric generators of the same type. The controlling apparatus is mounted on a large slate switchboard. The board is divided in panels, which are supported on an iron frame. Eight feeders leave the station for different parts of the line. Automatic circuit breakers are used and such other devices as have been found efficient in the protection of the lines of station machinery.

In the boiler room are located the steam generating part of the equipment, which consists of three return tubular boilers, built by Shapley & Wells, of Binghamton, three National feed water heaters, one Buffalo and one Worthington pump, Conover condensers, etc. The stack is 120 feet high, of iron, supported on a base of solid masonry. The fuel has been selected with a view to the best economy after a number of tests and buckwheat coal, costing from $1.60

to $2 a ton on siding a short distance from power house, and screenings, costing 75 cents or less per ton, are now used. The fact that the railroad siding does not reach the power house is a slight disadvantage as it requires extra handling of the fuel. The two kinds of coal are mixed, the percentage of screenings being a little in excess of the buckwheat coal. The cost of fuel per day averages from $4.69 to $5.91, the boilers being in use from 18½ to 20 hours per day.

The main car house is located near the above buildings of the company and is of frame construction, covered with galvanized iron. It measures 130 by 118 feet. Another car house of same size is located on the Asylum division, which is used entirely for storage. The company has at the present time eighty cars, twenty of which are motor cars and the balance trailers. The summer and winter cars are evenly divided as to numbers. The cars are from the works of the John Stephenson Company, Limited, and the Laclede Car Company. The trucks are Brill, Bemis and Taylor. The company has two handsome cars which were exhibited by their makers at the World's Fair.

The electric car equipments are General Electric 15 and 25 horse power double equipments, with a few Sprague No. 6 equipments. There are a number of extra equipments which permits the full number to be kept in service at all times. An electric snow plow is also included in the equipment together with other necessary tools for cleaning and keeping in repair the track, of which there is twenty-seven miles. The half-grooved nine-inch rail has been adopted as the standard in the city, but for suburban lines the T rail is allowed. A good, substantial road bed has always been the rule with the company, and in the construction of the track the ties are laid in cement and heavy, eight-bolt fish plates are used. This form of construction has given excellent satisfaction.

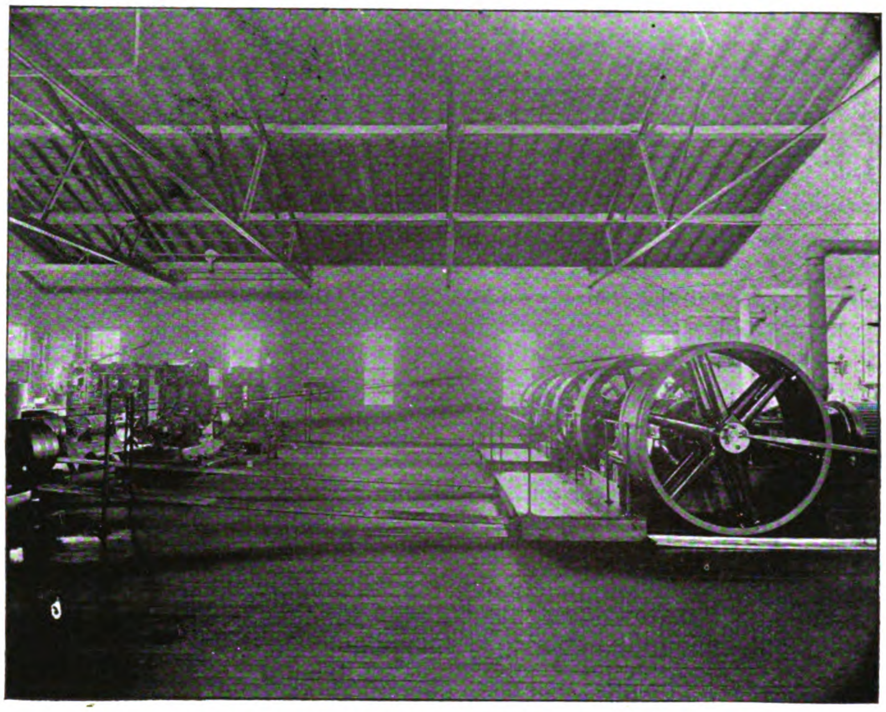


FIG. 3.—THE ELECTRIC RAILWAY SYSTEM OF BINGHAMTON, N. Y.—ENGINE ROOM.

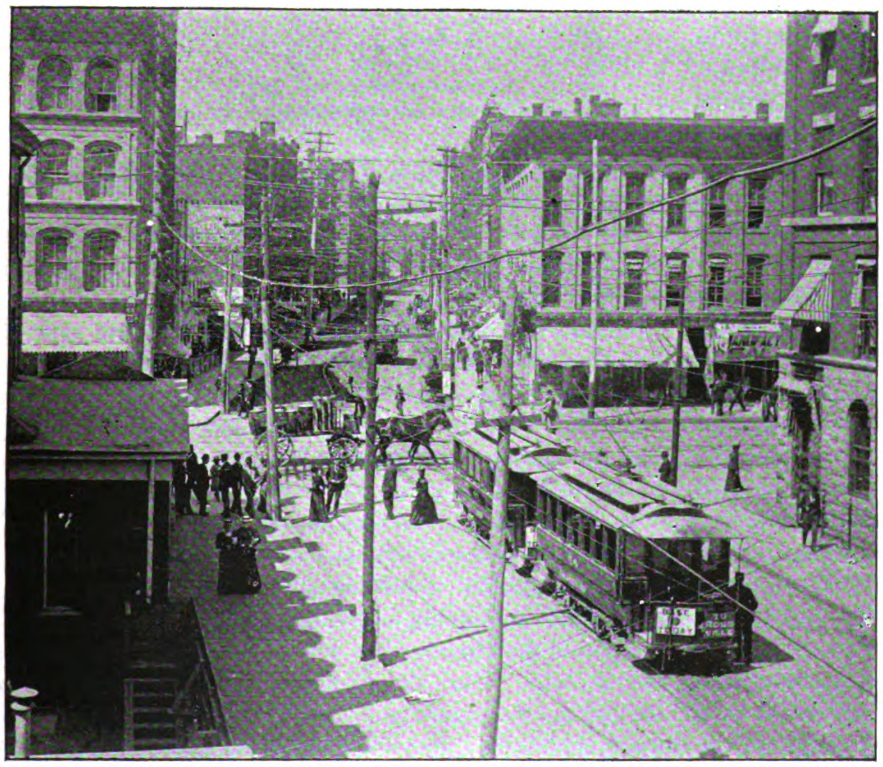


FIG. 4.—THE ELECTRIC RAILWAY SYSTEM OF BINGHAMTON, N. Y.—STATE ST.

The company conceded to the public when it took possession of the lines, free transfers to and from all lines and a uniform fare of five cents. It has also in other ways sought to encourage traffic and to retain the good will of the public. The road is well laid out and connects the public institutions, parks, etc., of the city. Summer and also winter travel has been greatly encouraged by the establishment of attractive amusements at the parks of the city. Free concerts, fireworks, etc., have been given in consideration for certain privileges. The company has the control of several private parks which are frequented by the public.

The management of the system necessarily involves a great many reports and the compilation of many detailed returns. Each conductor's record is entered daily, which includes his car number, date, cash fares, tickets sold, transfers, etc. The conductors are changed every week and the names of the conductor carrying the most passengers for the month, the past four months, and year, are posted every month. The records at the manager's office give the minute details of every day's run. The expenses of the road are as accurately and as systematically kept. An account of the fuel used is rendered every day, the coal being weighed before it is fed into the furnace. There is also a record kept of the time every piece of apparatus is used, so that the manager upon entering his office can tell by reference to the reports the actual work of the previous day or of any day. The working force is divided into departments and the head of the departments makes the report for that department. The consolidated company secured in 1892 a new franchise, perpetual, for all its lines, under terms favorable to the company. It has also franchises for lines running to several of the suburban towns on similar terms. The actual cost of the road up to the present time is placed at one million dollars and the value of the franchises, privileges, etc., is estimated at a like amount. The management of the company has pursued a policy that was not in any sense obligatory, but which has been proven the wisest in the end. Neat, pleasant cars, courteous conductors and a willingness to serve the public has been a method of which the public has shown its appreciation by a larger patronage of the street car lines. The officers and other investors that took hold of this system have found their investment sure as the reports of the expenses and receipts of the past year show. The percentage of operating expenses to receipts has been gradually decreased from 65½ for 1892 to 57 for year ending January 1, 1895.

The securities of the company are largely owned by the citizens of Binghamton. The officers are nearly all well known local business men. The president of the company is a member of the local house of Reynolds, Rogers & Lay, and also a director of the Binghamton Trust Company. He is well known in street railway circles and is president of the New York State Street Railway Association. Mr. Clark, the general manager, has been connected with the road for the past five years and the reconstruction of the system has been done under his direction.

Some Hints on the Building of Electric Plants.—IV.

BY CHAS. G. ARMSTRONG.

TEST AND OPERATION.

We will assume at this point that the plant has been properly installed, according to a well designed plan, and that it is adapted in every way to the needs of the work to be performed, at least, as near so as the designer could forsee. We will also assume that during at least the latter portion of the installation the designer and contractor have had under their tuition the engineer and electrician who are to operate the plant, and that the work has been done according to the best judgment and ability of the designer and contractor.

The next important step will be a test, for there are great differences in electric plants and in the ability of apparatus to perform the work called for in the contract, and these differences are generally not apparent to even a close observer until a thorough test has been made, which test should show the exact condition of the apparatus, their capacity, endurance, etc. Here, as in all other lines of work, I wish to caution the designer to be careful, conscientious and painstaking, in order to fully determine the real merits of the appliances and workmanship placed under the contract. The test should consist primarily of a voltmeter test on the wire insulation, by the use of a voltmeter of high resistance. This measurement can be readily and accurately taken, getting the insulation resistance over all and if it complies with the over-all measurements in the requirements of the specification and contract will effectually settle the question of insulation so far as pertains to leaks. But if it should show the resistance over all to be too low the next step would be to cut off different circuits to locate the fault and find whether it is general or local, whether it is of accidental origin or incidental to poor construction; if the former it may possibly be corrected quickly and clear up the plant; if the latter, it may necessitate the rewiring of some portion or the whole of the plant.

In "running down" a ground the voltmeter is not always the best instrument to use; the Wheatstone bridge or some modified form of it is preferable. In connection with the accidental ground above referred to, especially in electric light work in large office and hotel buildings, it will often be found that the canopy of the fixture instead of being up in position has dropped down and bridged the insulating joint, which together with a slightly grounded fixture would lower the insulation of the entire plant. Fig. 1, plainly illustrates this occurence and while it is apparently trifling in character it often leads to serious trouble between the contractor and the engineer. The slight rim at the top of the canopy designates an insulating joint which will prevent the canopy touching the ceiling (a point made in a former paper). Where an insulating ring is placed at the bottom of the canopy this short circuiting of the insulation joint cannot occur.

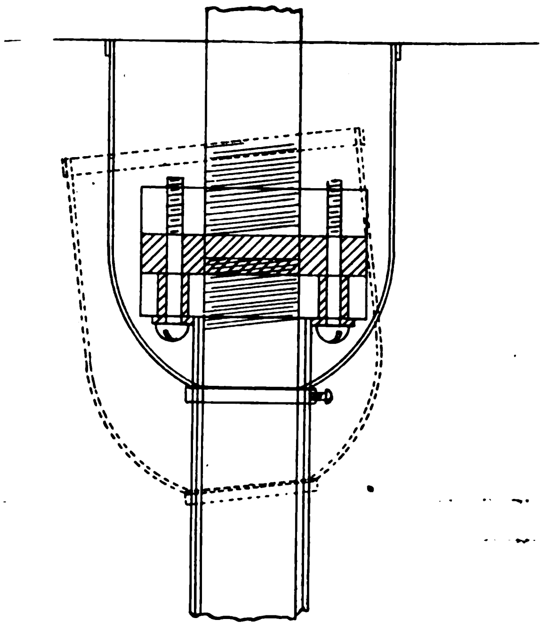


FIG. 1.—SOME HINTS ON THE BUILDING OF ELECTRIC PLANTS.

The next step would be a careful inspection of the general condition of the wiring plant as pertains to general workmanship and good material.

If the plant has been installed without expert supervision the inspector should give careful attention to the following suggestions on cut-out cabinets and some faulty methods of arrangement of dynamos and switch board, as in the experience of the writer these are points most apt to be overlooked or slighted by the contractor.

In connection with cut-out cabinets, Fig. 2 shows a form of cabinet which will not only show a high insulation test immediately after installation, but is much more apt to maintain its insulating and fire-proofing qualities for a longer period than where wires are massed behind the back of the cabinet. Where the wires lead in through the backs of the cabinet they may look very nice and straight on the front but almost invariably are a tangled mass, twisted togther in all sorts of shape before the plant has been in operation a year, but the method shown here, where all wires are kept on the face of the board, they must necessarily be straight at all times.

In connection with the arrangement of the dynamos and engines as regards the location of the switch board, Figs. 3 and 4 show a poor, and a proper arrangement; the main fault in Fig. 4, being that the commutators are thrown away from each other instead of together, making a maximum distance for the engineer to get from the commutators to the switch board, a fault which was explained in a former paper. Fig. 3 shows this fault corrected, embracing four dynamos. Fig. 5 shows another arrangement, where the switch board is placed at an inaccessible point near the engines, instead of near the dynamos.

Assuming that all insulation difficulties have been removed, that the general construction of the work is satisfactory and in accordance with the provisions of the contract and specifications, the next important stop would be an evaporative test on the boilers, and an economy test of the engines and dynamos, which can be made after the regular manner of a 12 or 24 hour operation under varying load to obtain the regulation of the engines and dynamos, and under full load to obtain the economy and capacity of the apparatus.

A bad habit has lately developed among bidders in general, of guaranteeing their apparatus to stand an overload of 10, 15, 20 or 25 per cent. as the case may be. This the writer regards as entirely wrong. If a generator is 100 kilowatts it should not be tested at 110 or 120 kilowatts, or any other number exceeding its guaranteed capacity, but should be tried at its full rated load, no more and no less.

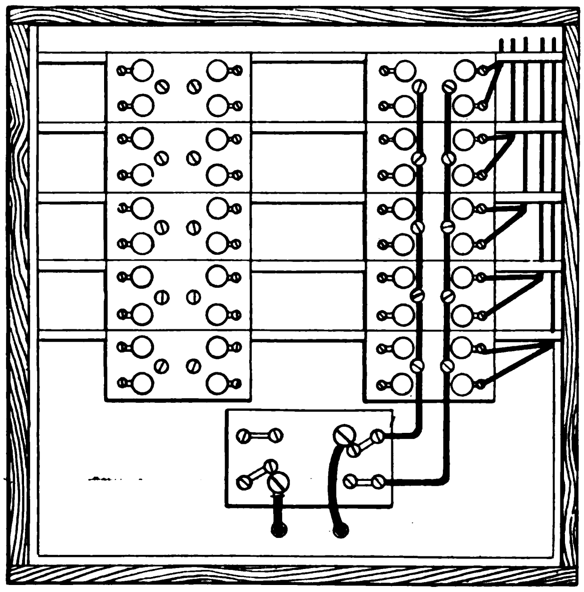
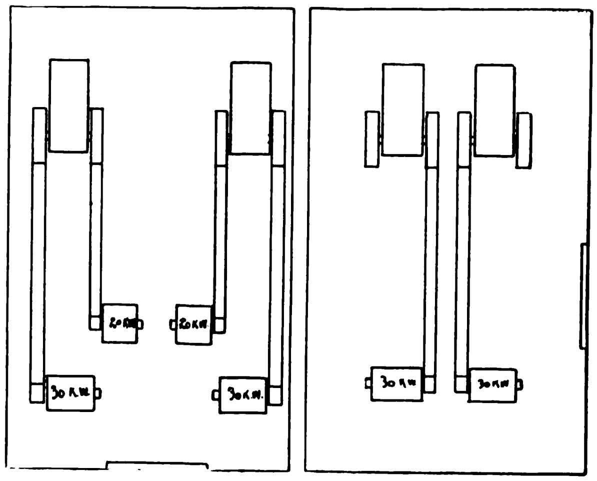


FIG. 2.—SOME HINTS ON THE BUILDING OF ELECTRIC PLANTS.

During this operative test the designer should measure the fall of voltage through the switch board, the heating limit of all conductors, and the accuracy of the instruments furnished.

Throughout this entire test the future engineer of the plant should have charge of the work, subject to the orders of the contractor and the designer or expert, for the reason that at the successful termination of this test the said engineer will have to assume entire charge and responsibility for the plant.

If "well begun is half done," we are about at the "half done" stage when the plant has been thoroughly and successfully installed and turned over to the engineer, for the reason that the aforesaid engineer has it in his power to make the plant successful or not, depending on the treatment he gives it. The most unfortunate part of the handling of electrical apparatus (and I believe every electrical contractor will agree with me in this statement) is that, no odds how skillfully the apparatus has been designed, no odds how faithfully it has been manufactured and no odds how conscientiously it has been installed, it will be a failure unless it is properly handled. It often happens, even in the largest plants, that after the owner has spent thousands of dollars in purchasing the best of machinery he will appoint some poor relation, or some friend of his janitor, or somebody else, whose sole qualification consists in the fact that he will work cheaply, and that he has served 20 years on a steamboat or in a sawmill and is therefore qualified to take charge of high-class apparatus. Instead of studying carefully the apparatus furnished him during the time when, perhaps, either the designer or the construction expert could have told him in a few moments what would take him weeks to study out, even if he were a brighter man, he holds aloof from them and significantly remarks that "when those dudes get through with the plant he will show them how plants ought to be run," and confidently informs his $35-a-month fireman that "the dynamos are not properly built," that "the engines are not nearly so good as those he had operated at his former place," and so on to the end of the chapter, the result being that the best efforts of the designer and manufacturer may be entirely thrown away by reason of neglect and incompetency in the operation of the plant.



FIGS. 3 & 4.—SOME HINTS ON THE BUILDING OF ELECTRIC PLANTS.

The above remarks are not made at random. It has been the writer's sad experience in a great many plants to have just such occurences. In one instance the engineer took the compound shunt and one side of the compounding off from one dynamo because it sparked a little more than the others did; and, strange to say, after all that work had been done it did not run quite as well as it did before. He also found that it would not maintain its voltage as well as it should, not because of what he had done to it, but because it was not properly made to begin with. He was thoroughly convinced, also, that a 20 kilowatt generator should never be run in multiple arc with a 60 kilowatt, as it was sure to be overloaded by reason of the greater size of the other generator. Another engineer in the writer's knowledge was positive that an engine was one-fourth loaded at one-fourth cut-off. Another did not like his plant because the equalizers connected the negative brushes instead of the positive brushes, without regard to its relation with the compounding, his reason being that the current flows out on the positive pole, and therefore will equalize quicker if the equalizer is joined to the positive brush. He gained his point in so far that he refused to operate the plant properly until the equalizer was changed. By carrying a varying voltage he easily convinced the owner that the plant needed attention, and the contractors were obliged to make these changes, since which time the plant has operated very satisfactorily for the simple reason that the engineer had gained his point.

Yet the engineer may not always be to blame for the ridiculous things which he does, from the fact that he does not know any better. Owners have to be educated up to the fact that engineers, firemen and electricians are laborers and "worthy of their hire;" and where competition is carried to such an extent as it sometimes is, leaving out the point of favoritism, where the lowest bidder is expected to install the plant and the lowest bidder is expected to operate it, the class of material obtained and the kind of men employed must necessarily be inferior. The idea of competition so carried away one corporation in the writer's knowledge that they advertised for the lowest bidder for an engineer to operate an electric lighting plant, the only qualification necessary being that he should be a man of family and would work cheap.

The engineering societies are doing much to educate and enlighten their members in many particulars. One society in Chicago, which comprises a major part of the stationary engineers of this city, gives out to its members a series of practical questions at each meeting which they are expected to answer at the next meeting. I do not know the parties who are propounding these questions, but from their practicability I have a very high regard for their ability. These questions are problems which come up in the every-day life of an engineer, such as, "What is the difference between 2 and 3 wire systems?" "What occurs when a neutral plug blows on the 3 wire system?" "How do you remedy a badly sparking dynamo?" "How to remedy an engine when it runs this way and that way;" "When it runs too fast or too slow;" "How to fire and care for boilers." It cannot help but result in great good, first, to the engineers themselves, and second, to the owners of plants who are so fortunate as to have such engineers in their employ.

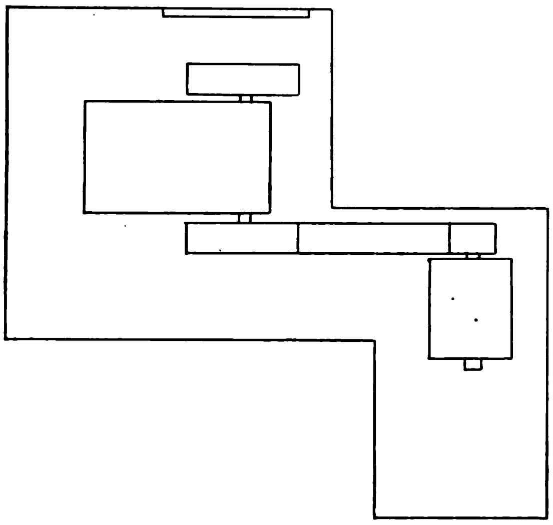


FIG. 5.—SOME HINTS ON THE BUILDING OF ELECTRIC PLANTS.

We will assume that the plant that we have been watching grow in the course of these articles has been placed in the hands of an engineer of this character, and is therefore safely launched on its way to solve the problem of economic conversion of fuel into electric light, heat and power, as the case may be. In the next article the writer will say some things on the formal introduction of this debutante to the public.

The annual report of the Metropolitan Railway Co., of Washington, D. C., showed receipts for the year of $348,-511.53. The company paid $58,600.50 in dividends, and $119,172.63 in wages.

Mr. Charles H. Wilmerding.

The new president of the National Electric Light Association, Mr. Charles H. Wilmerding, is one of the most active of the younger members of the association. He is highly respected by all, and his elevation to the presidency of the association is an indication of the esteem in which he is held. Being connected with one of the largest companies supplying electric light and power, his knowledge of the business is most thorough, and the association will be ably guided during the coming year.

The accompanying engraving is from a recent photograph of Mr. Wilmerding, and in this connection a short sketch of his life may not be out of place. He was born in New York City in 1858, and from 1869 to 1875 pursued his studies in Germany, Switzerland and France. Upon his return to this country he entered the class of '79 at Sheffield Scientific School, Yale University, taking the course of civil engineering. On leaving college his first practical experience was gained with the department of public works of Troy, N. Y., in the construction of new waterworks at that place. While at Troy he took a short course in assaying and metallurgy at the Troy Polytechnic, and then went to Leadville, Colo., where he followed for two years mining and civil engineering. After some time spent in the location and construction of the lines of the Denver and Rio Grand he returned east. Early in 1884 Mr. Wilmerding accepted an appointment as assistant engineer in the department of public works, New York City, and was engaged for two years on the location of the new Croton aqueduct and the reservoirs in Croton valley. The next professional work was in connection with the elevated extension of the New York City & Northern railway.

MR. CHARLES H. WILMERDING.

In January, 1888, he became a resident of Chicago, having become interested in the introduction of a storage battery. This, however, was abandoned to accept the position of superintendent of the Chicago Arc Light & Power Co. His recognized ability soon led to his election as secretary and treasurer of the company, and afterwards he became general manager of the company, a position which he held until the consolidation with the Chicago Edison Co. in 1893. Since that time Mr. Wilmerding has acted as general superintendent of the Chicago Edison Co.

The conventions of the National Electric Light Association have usually found him in attendance, and his name has appeared a number of times in the list of officers of the association. Mr. Wilmerding is, therefore, well-known to the members of the electric lighting industry.

Arc Lighting in its Beginning.

The following address by Mr. Chas. F. Brush at the recent convention of the National Electric Light Association, was listened to with marked attention by those present:

I will begin by calling your attention to the fact that dynamo-electric machines for electric plating antedated, by a considerable period, the use of such machines for lighting purposes. This is interesting from a historical standpoint, because when I invented the compound field winding for constant potential, now so generally used in lighting and power transmission, I applied it first to plating machines. That, I believe, is not generally known, and may therefore be interesting. Some of you will remember that all of the early Brush are lighting machines were single-slighters. Two of these machines were exhibited in the summer of 1877 at the Franklin Institute in Philadelphia. My friend at the left (Professor Houston) will remember all about it. It was soon after that when we sold a single-lighting machine to Dr. Longworth, of Cincinnati. This was one of the very first, if not the first sale of a Brush arc lighting machine. It was late in 1877, or the very beginning of 1878; and the doctor paid for it—paid cash for it. I hear these things are done differently now. At any rate, I went down to Cincinnati to show the doctor how to run that machine, and one evening while I was there he exhibited the light from the balcony of the building on one of the principal streets in which he lived. It was a 4,000 candle light, and of course it attracted a large crowd of people, and every man in that crowd was ready and willing and anxious to tell his neighbors all about it. I mingled in the crowd for a time to hear the comments. I found one man who had collected quite an audience about him. Calling attention to the solenoid at the top of the lamp, he said, "That is the can that holds the oil;" and speaking of the side rod of the lamp, "That is the tube which conducts the oil from the can to the burner." He did not say anything about electricity at all—a little oversight that was not noticed by his hearers.

These early single-light machines were quickly followed by two and four-light machines; that is to say, machines adapted to furnish two or four separate, distinct currents, each adapted to run a single arc light. Several of these machines were sold during the season of 1878 for lighting stores and shops. Among others, Mr. Wanamaker, of Philadelphia, bought a number to light his store. One of the earliest of these four-light machines was exhibited at works of the Union Steel Screw Company in this city to a number of invited guests. One gentleman on that occasion looked the whole apparatus over very carefully, perhaps a half hour, sized it up, and then, pointing to the line wire, he said to me, "How large is the hole in that wire that the electricity flows through?" Another gentleman, one connected with the screw company, observed in complete silence the machine running for perhaps five minutes. Then he fully digested the whole thing, and was ready to tell me all about it. He said, "The electricity in that thing is generated by that revolving business there, rubbing the air up against these iron blades (meaning the magnets), just as you get sparks when you rub a cat's back." I raised the objection that while that was a good theory, it did not fully meet the facts, but he would not hear anything from me. He said, "The whole thing is plain. If you should run that machine in a vacuum where there is no air, you could not get any electricity." His ignorance was so blissful that I thought it would be folly to enlighten him, and did not try to do it.

The year of which I am speaking—1878—was memorable in the history of electrical lighting. It was during that year that I had the great pleasure and good fortune to invent and develop and commercially introduce the modern series arc lamp with the shunt coil. It was this invention —I am sure you will all agree with me—which first made arc lighting from central stations commercially possible, and I think it may justly be considered as marking the birth of the electric lighting industry of the world today.

One of the first instances, I think quite the first instance, of the use of arc lighting for purely commercial purpuses was in our little public square in this city. Twelve lights were carefully installed in the park on high poles. The lamps used were of the ordinary, so-called 2,000 candle-power. In this connection, it will be remembered that a professor in New York once said he imagined the electrical companies arrived at the 2,000 candle-power by measuring it north, south, east and west, giving 500 each way, and added them all together. That measurement was taken in the interest of the gas company, as I have learned. While we were installing this plant in the public square a great deal of interest was manifested in the installation by the public, and on the occasion of starting the lights our little park was packed from side to side, and it was evident that many of the people expected a blinding glare of light, as evidenced by the fact that many of them had provided themselves with colored spectacles or smoked glass. Of course, there was a general feeling of disappointment at first in this respect, although every one was ready to admit he could read with perfect ease in any part of the square. After a few weeks when the novelty had worn off, and the people had got tired of staring at the arc, and had time to see how nicely the little park was lighted, the general verdict was that the electric lights in the park ware a pretty good thing after all; and that is the general verdict everywhere.

Of course, we had lots of trouble in the early days with carbons. The history of the carbon business is peculiar. Our first carbons were crooked, of course, and were soft, and high electrical resistance. and burnt out rapidly, and were very expensive. To decrease the electrical resistance and prolong the life of the carbons, we electro-plated them with copper, which is still done. This little scheme of covering the carbons with just enough and not too much copper was the only easy invention that it was my good fortune to make, and it paid fairly well, considering the effort involved, which was mighty small. It yielded, if I remember, something like $150,000 in cash royalties before the bottom fell out of the carbon business. They were sold at the rate of $240 a thousand. I say at the *rate* of $240 a thousand because nobody ever thought of ordering a thousand carbons at once. Fifty or a hundred was considered a fair order. As business increased a little we were able to reduce the price of carbons, and we did reduce it at one step to $150 a thousand. It was at a loss for a time, but then we held our own, and afterwards made a little money. We subsequently reduced them from $150 to $62.50, on the the theory that cheaper carbons would stimulate the growth of the electrical light industry, and our theory was proven correct. Their use was stimulated, and the business increased enormously, so that while we lost money on the carbons for a good while, later we made a handsome profit at that price. Others seemed to grasp the situation about that time, and competition sprung up, and it knocked the profits of the carbon business all to pieces. I presume now you can get your carbons for next to nothing a thousand, with "a beautiful chromo in each box;" and I have no doubt if you insisted, you could get a nice gold frame for each of the chromos. This is a pointer for you.

As to electrical lighting at the present day, most of you know more about it than I do, for I have been accumulating rust for several years, and I will not attempt to tell you anything about it, but will simply thank you for your attention.

One of the recent schemes for the economic production of power is to utilize the immense peat bogs of Ireland, Scotland and northern Europe. In the United Kingdom there are not less than six million acres of peat with an average depth of 12 feet. There are also large bodies in other parts of northern Europe. The schemes include the establishment of central stations and the transmission of power electrically to the cities and industrial centers or the use of the power in operating electric railways for carrying passengers or produce, etc.

Electrical Industries.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

Advertising Rates upon application.

Inventors have rendered an immeasureable service to the world. The present methods of manufacture are founded upon the inventions of this century, and yet the rewards which these inventors received have been extremely small in comparison to the benefits rendered. The work that led up to the invention has been in some cases of little consequence, in others it covered almost a lifetime. A single important invention has been the total of the work of some men, while others, as was the case with a gentleman whose death occurred recently, have produced one important invention after another. Their work is peculiar. Two seldom follow the same methods. It is a most discouraging vocation, yielding uncertain rewards. The electrical inventions of a little more than the past half century, the telegraph, the telephone, the electric lighting and power systems and the multitude of electrical appliances stand out with great prominence. The success of these inventors has induced many to take up the calling of inventing in many instances with a false idea of the work to be done. An examination of the inventions now especially valuable and their authors shows but few have secured great wealth from the inventions alone. There are a number who are counted as the wealthy men in the industry that have not secured so much of their fortune from the inventions as by the manufacture and sale of the devices. It is a false idea that the securing of a fortune is simply the originating of some useful device and that as soon as it is completed there are men ready to exchange for this device a check for a fortune. The public, especially the purchasing public, is naturally skeptical, and it is not an easy matter to convince it of the value of a new device. The inventor to make a success of his calling must possess not only the necessary knowledge and qualities to originate, but must, if he is without means to manufacture his devices, possess sufficient business knowledge to place advantageously his patent. If the article is new the objections of the capitalists must be met. The arrangements often made with articles unfamiliar to the public require the inventor to wait some time for returns until a demand is created for the article. The reward is thus not only uncertain, but slow. The electrical field has seemed to offer special inducements to inventors, and there are now scattered among the records of the patent office the specifications of thousands of devices which are absolutely worthless, of no practical value originally or later, by having been superceded by improved devices. It is needless to mention the amount of money and time expended upon these patents. The world is greatly indebted to the inventor, but before entering upon such a career one should consider well his capabilities and the vicissitudes of such a vocation. With some, invention is an easy matter in whatever line the attention is directed, but such cases are rare, and even when such is the case the return is uncertain. It would seem that the many opportunities which are offered at the present time, where the returns are sure, would be selected in preference to a calling that has so little to offer.

The convention of the National Electric Light Association at Cleveland marked the end of the first decade in its history. The association during this period has grown rapidly in size, influence and usefulness, and it enters upon a second decade with the brightest prospects. The strict attention that was given to the business of the meeting, the few interruptions and the general interest that was manifested in the proceedings were especially noticeable. There are few associations whose conventions give evidence of the life and enthusiasm that is shown in the annual gatherings of the National Electric Light Association. It is only to be regretted that the industry is not better represented. The secretary has been active in keeping up the membership of the association, but a still greater effort should be made to bring into the association a larger representation of the industry. The improvement in business conditions may enable many central station companies to join the association, which could not under the conditions of the past two years. Membership in a state organization should not be an excuse for not joining the association that covers the entire industry. The association for the present year is in the hands of able men who are thoroughly cognizant of the many details of the industry and also of the work of the association. Although the industry is young it might have been a surprise to some at the convention to find that there are a few who have retired from the business, but there are others, however, younger men, equally vigorous, who are carrying forward the work.

The meetings of the association at the recent convention were well attended, and the papers read were especially interesting and valuable. The committee on data was enabled to present a report in which more complete details were given of the operation of central stations. The number of stations from which complete reports were secured was, however, not so large. The plan proposed and the co-operation promised by those present at the convention will undoubtedly enable a still more complete report to be prepared for the next convention. The advantage of this data to central station managers is becoming better understood and a number spoke of the help it had been to them. It often happens that a manager may find the expenses of his station running too high, but is unable to know where he can economize. If he studies the table of data prepared by the committee he is able to determine the various expenses of other stations and under what conditions they are operated. If he finds a station with expense for a certain department operated under the same conditions as his own much lower, it is safe to say that he can find means to decrease the expense of the same department of his own station. The report gives very accurate information for comparison and gives sufficient details to form a very good idea of the power plant. The question of storage was well presented in the paper by Mr. Perry, and the discussion that followed brought up many ideas regarding the systems already tried. Various storage systems have been advocated during the past few years, and Mr. Perry in his paper presented the relative merits of the different systems. The position assigned to the storage battery, however, was not well taken, and the discussion on this point was particularly interesting. The subject of arc light carbons and the rating of arc lamps was well presented by Mr. L. B. Marks. The data presented from tests of carbons showed how uncertain the results from the arc lamp even when the watts are constant. The quality of the carbon used determining in a a measure the light given. The rating of the 2,000 candle power arc lamp by the 450 watt standard was not considered sufficiently accurate by the author. The investigation of the best material for the manufacture of carbon should be continued. If better results can be obtained by a different method of manufacture or the use of different materials the knowledge of such facts will be of great value to the industry. The paper by Dr. Bell dealt with an important subject, a single alternating system for light and power. The system described has but recently been introduced. The papers that were read were all on important subjects, with which the central station is directly concerned.

THE rapid advancement that has been made in the industrial arts as well as in the sciences during recent years has demanded that those who are engaged in the various industries shall possess greater intelligence and shall keep thoroughly posted regarding improvements and new processes that are from time to time introduced. Practical training schools and colleges, which have greatly multiplied recently, fit the youth for his future duties. The knowledge there gained, however, is but the foundation for subsequent experiences and more practical knowledge. In the laboratory, factory or workroom are gathered the knowledge of the industry as there conducted, but for information regarding other factories the investigations of other individuals and a knowledge of the industry as a whole the journals devoted to the industry must be consulted. Thus the electrical journals offer a supplementary knowledge to those engaged in the industry. The information they contain is instructive, stimulating, and should be to a certain extent entertaining. It occupies the place of an assistant and is the exponent of the latest practices. If in any way connected with the industry a person should subscribe for an electrical journal and should read it regularly. Not only the editorial columns, but also the pages of advertising. It is a mistake to think that because one don't want to buy something he can not learn something from the advertising pages. From those pages can be learned the latest types of machines being manufactured, the goods being sold and the companies who are doing business in these lines of goods.

THE various explosions which have occurred in the electric conduits and subways in the streets of London have been carefully investigated and lengthy reports concerning them have recently been submitted to the authorities. The cause of the explosions is ascribed to the accumulation of illuminating gas and air which was ignited by an electric spark. Poorly insulated mains were found which would account for the leak. The explosions were of considerable violence, sufficient, in fact, to break the heavy iron covers of the manholes. Although no persons were seriously injured, yet in crowded streets such occurrences are extremely hazardous to life. In devising means for preventing these explosions the reports recommended a more perfect insulation of the mains and to prevent the accumulation of gas that a system of ventilation be adopted. In connection with an investigation of the mains of one company it was suggested that a system of forced draught might be instituted and in addition everything done to prevent the entry of gas by making the sides and bottoms of the manholes impervious.

THE decision in what is known as the Bates Refrigerator case has just been rendered. The decision throws open to public use many of the most valuable patents, among which are the incandescent lamp patents, telephone and telegraph patents, etc. The opinion was written by Justice Harlan and defines very closely the life of American patents. While it places in the hands of the public these valuable patents, it, at the same time, takes away from their former owners the protection which has been the means of large revenues. The case has been one of the most important that has for some time been before the United States courts and for that reason was given the preference over other cases. The decision was thus reached much sooner than it would have been had it been placed in order on the calendar. The value of the patents affected, had the decision been rendered in the opposite, can scarcely be estimated. They are numerous and are used in different industries. The history of this case has been given in former number of ELECTRICAL INDUSTRIES as the case was advanced and will therefore be familiar to the reader. A number of lamp factories have been in readiness to commence business anticipating a favorable decision and will now commence the manufacture of incandescent lamps. The telephone people are especially well pleased with the result as it will put an end to much of the litigation that is pending. The opinion of the court as regards the life of American patents is as follows:

From this history of the several acts of Congress relating to patents for inventions it appears:

1. That in all the above acts Congress had in mind the date of an application for a patent, the date of the filing of specifications, and the date of the patent.

2. That under the act of 1836 a patent could not be granted if it appeared that the applicant was not the original and first inventor or discoverer, or that any part of that which was claimed as new had before been invented or discovered or patented or described in any foreign publication as in use in this or any foreign country; yet an original and true inventor was not to be deprived of a patent for his "invention by reason of his having previously taken out letters patent therefor in a foreign country, and the same having been published at any time within six months next preceding the filing of this specification and drawings."

3. That under the act of 1839 an inventor whose invention had not been introduced into public and common use in the United States prior to the application for a patent should not be debarred from receiving a patent by reason of his invention "having been patented in a foreign country more than six months prior to his application."

4. That under the act of 1870 an inventor whose invention had not been introduced into public use in the United States for more than two years prior to the application should not be debarred from receiving a patent by reason of its having been first patented or caused to be patented in a foreign country these words not being qualified, as in the act of 1839, by any reference to the date of application.

5. That when an American patent was granted in conformity with the sixth section of the act of 1839 for an invention "patented in a foreign country more than six months prior to his application" it expired in every case at the end of fourteen years from the date or publication of such foreign letter patent, and when, in conformity with the twenty-fifth section of the act of 1870, a patent was granted for an invention, "first patented or caused to be patented in a foreign country," it expired "at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term."

6. That under the revised statutes, while a patent for an invention could not be withheld nor deemed invalid "by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States more than two years prior to the application," yet "every patent granted for an invention previously patented in a foreign country shall be so limited as to expire at the same time" with the one having shortest term, "in no case to remain in force longer than seventeen years."

Electric Lighting as an Advertising Feature.

Since the electric light came into general use it has been employed more and more as an advertising feature. At first the simple fact that a store was lighted by electricity was a sufficient advertisement. This, however, soon became too common and efforts were made to employ it in some novel manner which would attract the attention of the public. A few lights in the show windows which lighted not only the goods there displayed but cast a flood of light on the street in front of the store were next used. This plan has been enlarged upon to a considerable extent and in front of many of the larger stores there are now found arc lamps suspended at frequent intervals above the walk; the store is thus made conspicuous from each direction. Electrically lighted devices and signs are employed and have been especially noticeable during the holiday seasons. The signs and illuminated devices were much more numerous during the past year, and were more elaborate in design. This feature has been adopted by the large dry goods houses and those dealing in general merchandise. The object is to catch the eye of the public, and to do this, something quite out of the ordinary must be used. It is not a massive building, with dark walls and signs, but something bright and flashing, something that forces the eye to give it attention that attracts the public. This fact is well understood and recent installations of this kind show how valuable a feature this is now considered. The incandescent electric light possesses unique properties for decorative lighting; the system is flexible and the lamps are easily arranged in attractive combinations. While the arrangement of the light is one element of the design the combination of colors, that may be used, permits of a greater variety and more complicated designs. This feature is capable of a special study as there seems to be no limit to the variety or the extent to which the incandescent electric lamp may be used as an advertising feature.

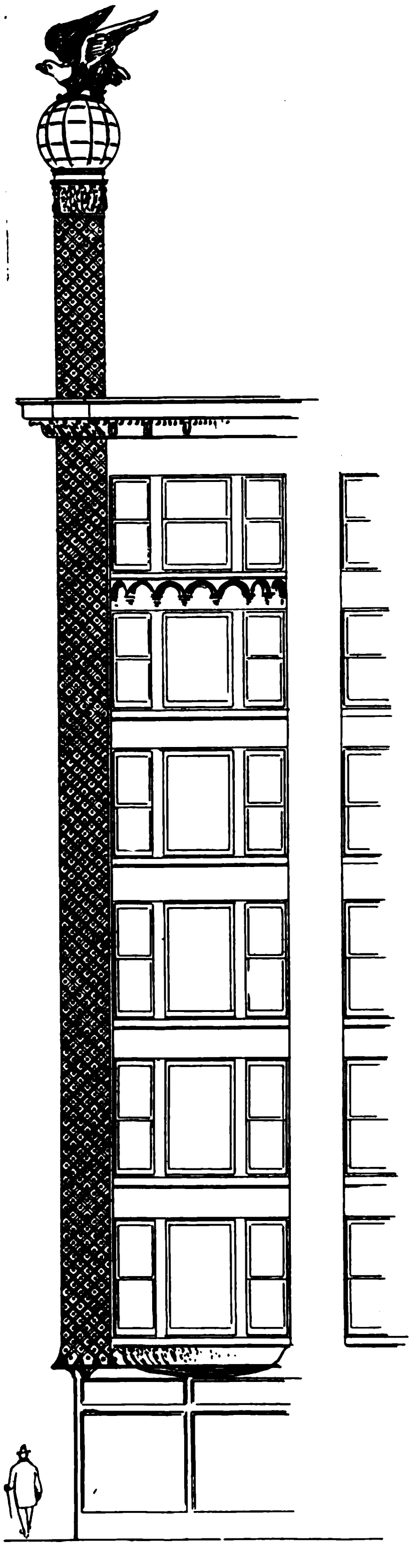


FIG. 1. ELECTRIC LIGHTING AS AN ADVERTISING FEATURE.

Probably the most elaborate installation of this kind is now being erected at the State Safety building at the corner of State and Van Buren Sts., Chicago, which is to be occupied by Rothchild & Company. A portion of this building is nearing completion and the electrical equipment is well along. The general plan of the lighting was designed by Holabird & Roche, the architects, and the details were worked out by the contractor, the L. K. Comstock Co. The cut Fig. 1 gives an idea of the tower on the corner of the building which extends from the top of the first floor to some thirty feet above the roof. This tower is studded with incandescent lamps, of which there are 2,868. There are thirty around the base, 2,068 between the base and cornice, 720 above the roof and 50 in the large ball at the top,

Besides these lights there will be in a huge sign, which will extend along the front of the top of the building, 2,800 more lights. There will also be hundreds of lights in the show windows and the interior will be well lighted with both arc and incandescent lamps. The interior is wired with interior conduit throughout and is put in in such a manner that either arc or incandescent lamps may be used or both at the same time without disturbing the system of wiring.

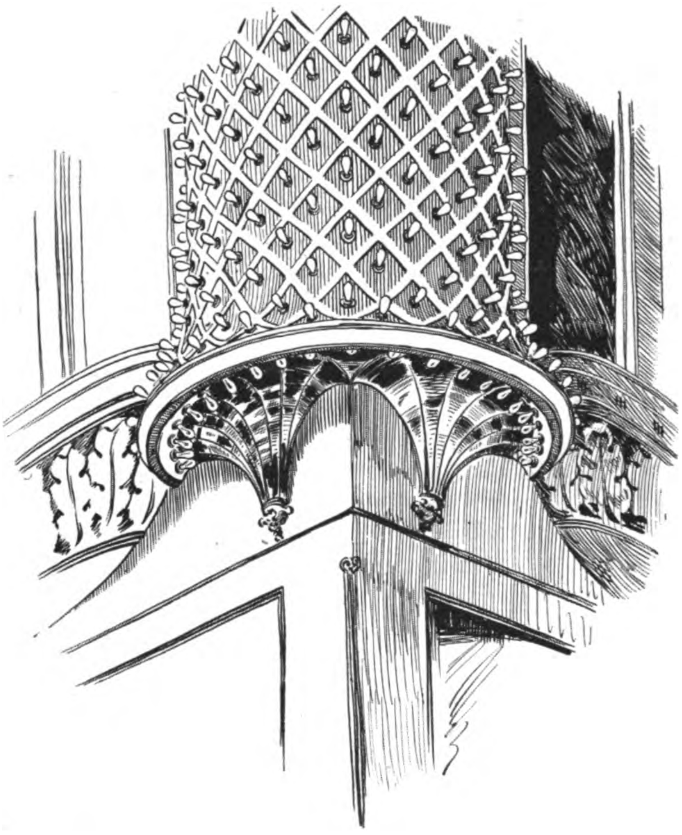


FIG. 2.—ELECTLIC LIGHTING AS AN ADVERTISITG FEATURE.

The lights will be controlled by a large commutator placed in a fire proof room in the basement. This commutator will be run by an electric motor. The lighting combinations will be changed from time to time as it is desired. The first plan is to have a ring or band of light pass up the column and then run out across the sign at the same time the lights in the ball flash out. This effect will be especially striking. This revolving switch or circuit changer was designed and manufactured by Goltz & Sinclair of Milwaukee, Wis., who are making a specialty of this class of work.

In carrying out the general ideas of the architects and owners a large amount of special work was necessary. The installation in many respects was new and it was necessary to work out the details and to originate methods of construction. The tower is constructed entirely of iron. The framework is iron anchored to the frame of the building. The casing is sheet iron ornamented in the manner shown in the cuts. In Fig. 1 is shown an elevation of the tower. The location of the lamps are there approximately indicated. Fig. 2 shows the design of the base of tower and the general appearance of its exterior. One of the first questions that was taken up was the method of wiring. An iron ladder permitted the wiremen to reach any point in the tower from within. The plan decided on, since all circuits must be run to the basement, was to construct two conduits, one for the wires of one polarity and another for the wires of the opposite polarity. The wires come out of these conduits through porcelain insulators. One wire is taken out between each two rows of lamps, one wire of the circuit coming out of one conduit and the other from the other conduit. Two rows of lamps as indicated in Fig. 4, are wired on each circuit.

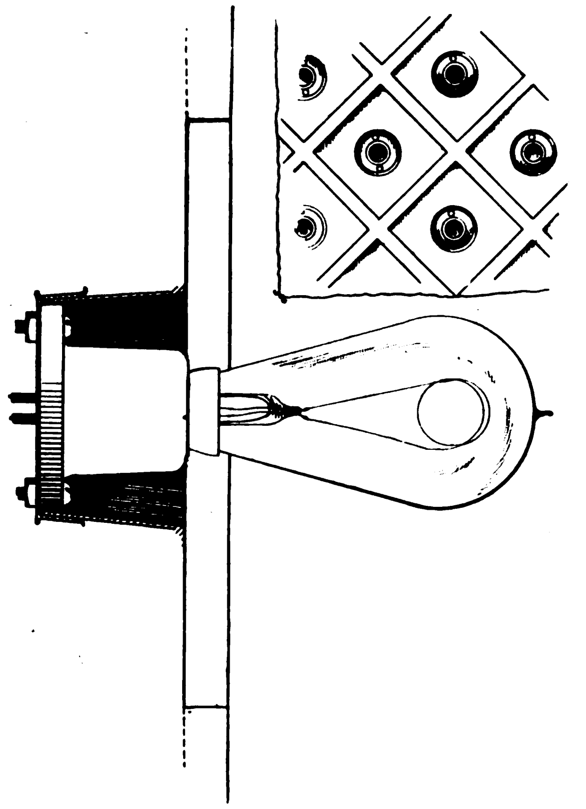


FIG. 3.—ELECTRIC LIGHTING AS AN ADVERTISING FEATURE.

The next question, after the method of wiring was satisfactorily settled, was the manner of attaching the sockets so that the lamps would be accessible for renewal. The detail drawing Fig. 3 shows how this was accomplished. The iron sheathing was constructed with holes two and three quarters inches in diameter for the lamps. A flange projected within from around the edge of the hole and over this a cap was fitted. The socket was bolted with small bolts to the bottom of this cap. The socket used is the waterproof socket recently placed on the market by the Bryant Electric Co. The cap with the socket and lamp attached is easily taken off and the lamp drawn back into the column.

Special care has been taken to protect the wire as much as possible. The tower is constructed entirely of iron and is therefore fireproof so that there is no danger of fire. The plan of running the wires in two conduits leaves the center of the tower free of wires. The lamps used are of ten candle power and are run twenty-one on a circuit. The success, that this installation promises, will undoubtedly lead to more elaborate installations by other houses. This installation is entirely of a permanent character and in that respect differs from the most elaborate attempts so far made.

This department of electrical construction is comparatively new and is worthy of special study. It ranks with interior decorative lighting which is now given special attention. The company which is installing this plant, the Louis K. Comstock Co., has placed the electric installations in a number of the finest interiors in the west.

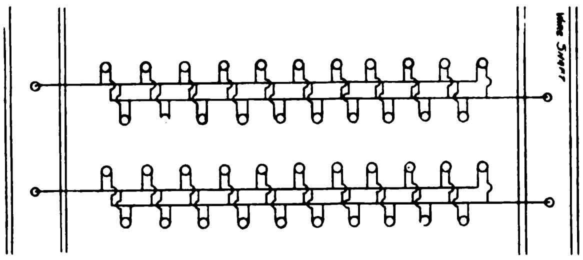


FIG. 4.—ELECTRIC LIGHTING AS AN ADVERTISING FEATURE.

The Mexican Exposition.

An exposition in the city of Mexico opening in April, 1896, and continued for six months has recently been announced. The plan of the exposition proposed that each state and country of both North and South America shall participate in the exposition. The location is favorable for bringing together the manufacturers and consumers of North America with those of the southern countries. In the plan for making exhibits it is proposed that a company shall be formed for each state in the union, which shall have charge of the exhibits of that state at the exposition.

A Quarter of a Century Under Government Control.

It was twenty-five years ago on January 29th that the telegraph lines of the United Kingdom passed from the hands of private companies to the government. Although the extensive system now owned by the government has been built up under a government monopoly, many still believe that had the lines remained in the hands of private companies the service would now be more elaborate and complete. The immense force of employes now in the service and the expense of maintaining the lines are not generally understood.

The copper production for the year 1894 is estimated at 159,686 tons, or an increase over the previous year of 15,717 tons. The increase in amount of copper mined was due to the larger output of the Montana mines which have constantly increased their yearly output while the output of the Lake Superior region has decreased. The production of mines outside the United States for 1894 was about 100,000 tons, which is also an increase over the production of previous years.

During the past month the Chicago City Railway placed electric cars on a number of the cross town lines. The 26th St., 31st St. and several branch lines are now operated by electricity. The change is greatly appreciated by the residents of these sections of the city by whom the horse cars had long since been considered as behind the times. The lines of the Chicago City Railway with few exceptions, are now operated either by electricity or cable, and persons residing on the south side are sure of quick transportation to the center of the city.

PROCEEDINGS OF THE TENTH ANNUAL CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The National Electric Light Association was called to order for its tenth annual convention by President Francisco at 11 o'clock Tuesday morning, February 19th. The address of welcome was made by Mayor Robert Glee of Cleveland. An interesting address followed by Mr. James H. Hoyt of Cleveland, who reviewed the history of electric lighting and the present importance of the industry. Many amusing references were made which were greatly enjoyed by those present. The address of Mr. Charles F. Brush on the early history of electric lighting was very entertaining. The reminiscences of the early days when carbons cost from one hundred and fifty to two hundred and forty dollars a thousand were very interesting, and the incidents related concerning opinions held by certain individuals respecting the electric light were exceedingly amusing. The balance of the morning session was consumed by the president's address.

THE PRESIDENT'S ADDRESS.

The growth of the association and the unprecedented development of the electric lighting industry was covered by the president in his address. A few abstracts are taken from this address, as follows:

"A recent craze has been developed for municipal ownership and some aldermen of various municipalities have heard a rumor that there is one instance where something was created for nothing. Therefore, they believe that electric lights can and ought to be produced in the same way, especially if there is a prospect that the benefits to be derived from this style of production are to revert to themselves. This subject should have the careful consideration of the members of this convention.

"The membership and financial condition of the association never was in as flourishing a condition as at the present time, and your secretary deserves credit for his able and energetic work.

"There is another subject that should receive immediate attention—that is, so amending the constitution as to arrange the time of the annual meeting at a more convenient, as well as a more seasonable, time of year. Other rules relating to various plans of doing business should be changed to apply to our present style of work.

"The relations between central station companies and manufacturers have been discussed by this association at every convention. The time has arrived when the plan adopted by manufacturers for destroying the business of the local company, by establishing competing plants in places where there is only business sufficient for one, must be abandoned. This has been done with the intention of compelling the local company to either buy them off or see their own business ruined."

TUESDAY AFTERNOON SESSION.

The first business of the afternoon session was the reading and discussion of the paper by Nelson W. Perry on "The Storage of Energy Essential to Central Station Economy." The paper gave the cost of engines, dynamos, buildings, etc., for an electric plant, in fact for a complete plant installed under ordinary conditions. From this data was derived the annual cost of one electrical horse-power, which, under ordinary conditions and under a constant load, costs $48.68; under a variable load, under conditions similar to those of electric lighting station, cost $117.78. The electric horse-power in the central station costs, therefore, $69.10 more than it would otherwise cost. The author estimates the amount that might profitably be expended for storage, in order to produce a steady load for the plant. The conditions under which a storage system will pay and those under which it will not are both considered. Storage batteries, gas storage, thermal storage, steam and feed storage and combined systems are touched upon as regards their relative cost and economy in operation. Regarding storage batteries, he says there are some conditions under which they will prove economical and others that they will not. "Then, on the other hand, the employment of the storage battery is limited entirely to the storage of energy when generated in the form of electricity; not only this, but it is still further limited to direct currents, and is therefore of no avail in stations sending out alternating currents."

The calculations which he makes he says show that with coal at $1.75 per ton and a load line, such as that assumed, there will be an annual saving with the feed-water storage of $20.20 per horse-power; by steam storage a loss of 6 cents, and by combined feed and system storage an economy of $23.36.

"If, on the other hand, we assume coal to cost double this, or $3.50, which would perhaps be nearer the average condition obtained in this country, our energy without storage would cost us $148.40 per annum electrical horse-power. With feed storage, $117.58; saving $83.82. With steam storage, $134.77; saving $13.63. With combined, $111.35; saving $37.05."

In the discussion of this paper, Prof. W. M. Stine presents some valuable facts regarding the care of storage battery plants, of which the following is an abstract:

An accumulator plant must be intelligently and judiciously cared for. Its efficiency at best is low, and should the charge or discharge be continued too long the total efficiency is greatly lowered. The accumulator is not automatic in its action in the same sense that a transformer is and requires constant inspection and testing and supervision as well when in action. The savings which it will effect at the coal pile is offset by the price paid for an attendant, and this fact must not be overlooked when estimating its economy. The cost of attendance is relatively high for small plants. Many people seem to think that a battery can be left to take care of itself on discharge, but when the economy of the plant is more important than its convenience this is not possible.

It may be of interest to call attention to the nature and extent of attendance. During charging the current must be regulated so as not to exceed a certain maximum, and since the tendency on charging is to decrease the current it must be frequently regulated to hold it at the proper strength. The battery itself should be inspected at intervals during charging, to detect excessive gasing and unequal action of the individual cells. Stress should be placed on looking after each cell, rather than paying attention to the battery as a whole. A good practice is to wire each cell to a circular switch connected with a reliable voltometer. In this way the voltage of each cell can be readily taken and a bad one located. It is not sufficient to take the volts at the ends of a series during charging as an indication of the extent of charge. A sulphated cell may cause a larger drop, owing to high internal resistance; the connections, when badly corroded, absorb a relatively great drop. These two causes may make the main voltometer indicate the termination of the charging, when, if the voltage of the cells was taken separately, the charge would be found to be far from complete. The separate voltage plan is then a check on such faults as bad connections and poor cells and will attract attention to their existence, so they can be remedied. As the electrolyte evaporates or is lost through gasing, it must be frequently renewed and brought up to the standard density. The hydrometer is a piece of apparatus that must not be forgotten in the installatian of a plant. There is always danger that the small pieces which become detached from the plates will cause a short circuit. Again, to prevent this, a narrow strip of thin rubber should be run between each pair of plates. During the discharge the attendant should see that the discharge capacity of the battery is not exceeded for if this occurs frequently the plates will be damaged. As the discharge proceeds the voltage must be taken over each cell to prevent the weaker ones from over-discharge. No matter how excellent the battery may be it will need frequent repairs, and such repairs are not only tedious but take a great deal of time. This consideration must be allowed for installing a plant or it will result in disappointment.

An accumulator differs from the dynamo or engine in rate efficiency of working. A dynamo is most efficient when working near its rated capacity. The accumulator is not. The lower the rate of charge and discharge, within certain limits, the higher will be the efficiency.

Trade competition has led to a large over-rating of cells. The ordinary 300 ampere hour cell will show the best results and economical life if worked to only 75 per cent of its rated capacity. In the main this is true of all sizes, unless the maker has rated his plates especially low. If worked too high a too large proportion of the plate is converted into active material and in time much of this active material will scale off and fall to the bottom of the cell. The body of the plate, too, will become soft and spongy and completely fall apart. Experience has shown that this action is not confined to any particular form of plate, but seems inevitable at some period in the life of all plates. If a plate is abused it soon makes its appearance; if properly cared for it comes only after a long and useful life. It is a matter that should be carefully looked after, for if detected before the softening has gone too far it may be partially remedied. The soft plate should be removed, washed thoroughly and dried: then worked as a negative and reduced to spongy lead, when it is in a condition for reforming. Built up in this manner it can be restored to its place in the cell.

European experience has shown that it is possible to reach an efficiency in watts of 75 per cent or 80 per cent. At present a good cell should show an ampere efficiency of at least 90 per cent. These are certainly good results, but would seem capable of improvement.

Under the title, "A New Method of Measuring Illumination," Prof. E. J. Houston described an instrument called an illuminometor and explained its use. Regarding the instrument he said:

"A certain intensity of illumination is required to render a definite object viewed at a definite distance clearly delineated to the eye. It is well known that the illumination received upon a printed page of a book or newspaper must have a definite value in order to render the printed characters legible and that the intensity of the illumination so required will, for a normal eye, depend upon the size and character of the print.

"We employ this principle in the operation of our illuminometer as follows: A special test object of, say printed characters, is placed in a darkened box, sufficiently small to be readily carried in the pocket. The test object is exposed to illumination received from a translucent plate of porcelain or opal glass, which receives directly on its surface the illumination whose intensity is to be measured. Since the test object receives the light from this plate by transmission and subsequent diffusion, it is the area of the translucent plate exposed to the test object in order to just render the latter legible to the eye that determines the intensity of illumination upon the plate. A focusing eyepiece is placed opposite the test object for purposes of annulling the effect of any focal abnormalities of vision. A sliding shutter, movable by a milled-headed screw, permits the effective area of the opal glass plate to be reduced until the amount of light received by the test object just permits of its legibility."

The instrument is small in size, can be carried in the pocket and used by any person of ordinary intelligence. A discussion followed the reading of the paper, in which it was mentioned as one of the weaknesses of the instrument that the reading depended on the eye of the observer, which cannot be considered accurate.

WEDNESDAY MORNING SESSION.

The session which opened at 10 a. m. was first occupied by the reading of the report of the finance committee. This report showed receipts of the year to have amounted to $5,998.69 and expenses $5,449.95, leaving a balance of $548.74. Mr. W. E. Harrington, of Philadelphia, then read a paper on "The Correct Method of Protecting Electric Circuits." This paper had been printed and the copies were distributed, that those present might follow the author in his reading. By the use of curves and diagrams the rise of currents with the time element was illustrated, showing a so the inefficiency of fuses and the special fitness of the magnectic cut-out as a circuit breaker. Tests with currents of different kinds and with special apparatus for determining the elements of time, quantity, etc., were described. In conclusion the author says: "All switchboards and minor lighting circuits should be protected by automatic (as regular time element) magnetic circuit breakers, and the urgency of this will appeal to the exchequer of the management of our many electric light and power stations when the full meaning and import of Helmholtz' law dawns upon them."

This paper was followed by one on "Large Arc Dynamos," by C. N. Black, in abstract as follows: "Glancing back over the past fifteen years and noting the rapid progress made in all branches of electrical engineering, it appears strange that arc dynamos have met with so few changes, more especially so when we remember that arc lighting was one of the first branches of the science reduced to practical use on a large scale. It is impossible to ascribe this to the fact that there was nothing left to be desired in the design or the efficiency of this type of machine, since it has always been notoriously weak in respect to efficiency, and has by no means kept pace with the incandescent dynamo. Within the past eighteen months, however, various manufacturers have awakened to this fact, and we have seen the results in numerous descriptions of arc dynamos appearing from time to time in the technical journals. The general tendency seems to be toward larger units and lower speeds; but, although the increase in size has, of course, increased the efficiency to some extent, we still notice the massive field magnets with their enormous amounts of copper and the small armature, which alone is enough to account for the inefficiency of these dynamos.

Another noteworthy fact is that, with one exception, which perhaps I need not mention, all the new machines thus far described are of what is known as the closed coil type. This is the more remarkable when we consider that fully 75 per cent of the arc lights in this country are run from open coil dynamos. The open coil dynamo at the very earliest date appealed to such men as Charles F. Brush and Elihu Thomson as being especially suited for this constant current work, and by the remarkable genius of these pioneers was so perfected that today machines with scarcely a single alteration from the design of fifteen years ago are being sold in competition with the latest closed coil dynamos.

"The question as to the reasons for this preference naturally suggests itself, but before answering it I will briefly describe some of the most marked points of difference between the two classes of machines. As the name implies, the open coil machine has the separate coils, or sections of the windings of the armature entirely distinct one from another. In other words, they do not form a closed circuit. It will be observed in the open coil armature that each coil or bobbin, as they are generally called, has a large number of turns, and that there are but few commutator segments; while in the closed coil armatures we have exactly the reverse, namely, few turns per coil, and a large number of commutator segments. This is due to the different manner in which they commutate. In the open coil machine a large amount of self-induction in each bobbin is by no means objectionable; in fact, one might almost say that it is essential in order to obtain the best results, while in the closed coil machine the less self-induction there is in each bobbin the better the action at the commutator. The latter is true of all closed coil machines, whether for arc or incandescent lighting, as all engineers well know who have had any experience in the designing of dynamo electrical machinery."

Tests of these machines and their circuits followed and a description of the Brush 125 2,000-candle power light dynamo was given, which has already appeared in these columns.

In the discussion of this paper Mr. S. M. Hamill said: "During the past year the Brush company has built large arc dynamos from eight to ten thousand lights capacity. The inquiries concerning them do not come in from the new installation companies, but almost entirely from existing stations. This is natural, for the reason that nearly all our large electric light stations are quite centrally located in the large cities of the country, where real estate is expensive, where the business is growing and where it is a question either of going away further from the center of the cities or purchasing additional real estate at great expense, in order to increase the capacity, or to exchange the small dynamos for larger ones." A number of instances were here mentioned where this had been done.

Prof. Thomson discussed the question of open and closed coil dynamos, and in his remarks said : "Considered purely as an electrical affair, without reference to the practical uses, there can be no question but that the closed coil dynamo is the better electrical structure. I say considering it simply as a dynamo ; but when you come to use that dynamo in the conditions of practice there may be considerations which will modify that conclusion. I am really sorry that Mr. Wood is not here, the champion of the closed circuit dynamo. We might have had a discussion, bringing out the strong points of the other side. When I first entered the business my object was to get that kind of a machine which, put into ordinary hands, men of no experience with machines of the kind, could run successfully and keep the lights going, and the object was to reduce to the utmost simplicity those parts which were subject to wear and could be injured by bad handling. Therefore, the commutator was reduced to very few parts and it was constructed so that if anything happened to it, to injure the segments, it was a simple thing to take off the segments and put on others. That could not be done if the commutator contained from one to two hundred segments."

WEDNESDAY AFTERNOON SESSION.

The program was slightly modified for this session and one of the topics for discussion was called up: "How to Light Large Cities." Owing to the absence from the hall of the persons to whom this subject had been assigned, the discussion was not continued to great length. Mr. Wilmerding, of the Chicago Edison Co., opened the discussion by a few remarks on city lighting in Chicago as follows: "The cost of lighting in Chicago, according to Professor Barrett's figures of a year ago, if I remember rightly, was $96.25 per lamp. This figure, it was stated, included nothing of interest, depreciation, insurance, taxes, etc., or what in a lighting company would be called expenses. In other words, it might be said to include simply labor and material. The cost per lamp installed was something in excess of $500, which, at 6 per cent interest on the original investment, would amount to $30 per lamp, and a fair depreciation might be 6 per cent, which would add another $30, or a total of $60 to the cost; in other words, about $156 per lamp per annum. We are furnishing a few lamps to the city at $137.50 per annum; so that, as a matter of fact, we are supplying lights at a lower cost to the city than they can make it themselves. On that basis, it seems reasonable to suppose that large cities should be lighted by private corporations rather than by the city itself. There is no question but that in every municipal organization in this country the cost of carrying on what may be considered a commercial or private business is much greater than where it is carried on by a private corporation, where all expenses are carefully considered.

Mr. Redman—of Rochester.—I think the best answer I can give to this question is to give a description of the city lighting by the two companies with which I am connected. The city of Rochester, with a population of 165,-000, has 2,010 arc lights on the streets; 1,109 Brush, and 901 Rochester. In the center of the city we have one street 7,940 feet in length, with no wooden poles, no overhead construction except the trolley wire. That street is lighted with 76 pair of 8-ampere lamps, on the Edison system, and give general satisfaction. They are so popular that the cry is for lighting the entire city on that system.

This discussion was followed by a paper on the Monocyclic system by Dr. Louis Bell, which was of too great length for insertion here. The system has already been described in these columns. The discussion was carried on as to the merits and details of the system by Messrs. Steinmetz, Kelly, Scott, Prof. Thomson and Dr. Bell.

EVENING SESSION.

The evening session, which commenced at 8 P.M., was well occupied by Mr. A. J. Wurtz in "Practical Demonstration of Protecting Lines from Lightning." His talk was very interesting and instructive and was greatly improved by the practical illustrations given. In these illustrations the Wurtz non-arcing lightning arresters were used. The fact that lightning does not always take the shortest distance to earth was brought out, and the range of distances was given as within nine-sixteenths of an inch; thus the discharge would pass a distance when there were shorter spaces connected in multiple with it. Other facts were illustrated and the excellence of the non-arcing metal-lightning arresters was explained.

THURSDAY MORNING SESSION.

The discussion of Dr. Bell's paper, which had been closed on account of the lateness of the hour on the previous afternoon, was opened at this session by Mr. Gardiner, of Pittsburg, who described an installation and its operation. The report of the committee on data was then called for and its chairman, Mr. H. M. Swetland, offered the following report:

Mr. President: "The information contained in the tabulated report submitted herewith while recording data from fewer places than usual is believed to contain correct information and more than usual detail. Certain classes of equipment are not reported in sufficient numbers to warrant correct averages, but every central station manager will find in the table a style of equipment sufficiently like his own to enable him to compare results with at least a few others who are similarly equipped. The table contains reports from twenty-four stations using coal as fuel. The highest economy is shown in report No. 22, where 262 watts are generated from one pound of coal, the plant furnishing nearly 23,000,000 watts during 24 hours, the equipment being triple expansion engines with dynamo on the engine shaft, and horizontal water tube boilers with heaters, without economizers, the firing being done by hand. This result is secured from one-half each soft coal and hard screenings. An examination of this report proves it to be a high average for twenty-four hours, as with an evaporation of 9.37 pounds of water per pound of combustible, and a water consumption of 17 pounds per horse power, allowing ten per cent non-combustible in the coal, and taking the efficiency of the generators as stated at 85 per cent, we have $\frac{9.37 \times 90}{17} \times 746 \times 85 = 314$ watts produced from one pound of coal. This average is much nearer the theoretical efficiency of a modern steam plant than any report previously received by this committee.

Taking an average of the ten reports from stations generating over 5,000,000 watts in 24 hours we have 147.5 watts per pound of coal, or a production of one electrical horse power for four pounds of coal on a basis of the efficiency of the generating machinery as stated in the last report by this committee.

Previous reports by this committee have been criticised as inaccurate and incomplete, and an attempt has been made in the work here submitted to improve it in both these particulars. From the first, the results of this work have been handicapped by reports from the central stations incorrect, incomplete, and based upon a variety of testing instruments constructed without any absolutely uniform standard. And again many central station managers do not wish to have their work made public, and in order to get at the results secured by these people, the information has previously been furnished to the committee, through your secretary, in such a manner that the committee were relieved of the responsibility of the exact source of the information furnished. This, in a measure, defeats the main object of the work. . . . . .

A careful review of this work for the past three years reassures this committee that the present method of securing data from central stations by individual effort on the part of the committeemen, with the understanding that the information is to be held confidential, meets all the requirements, as any manager can communicate with the author of any report either through the committee or the secretary of this association, and reports can be had in this way from many who are not as willing to have their work made public as is our friend from Atlanta. Several members of the present committee were unable to give the matter attention and the table is therefore made from a limited number of reports. If the succeeding committee could pledge its membership to secure at least twenty-five reports each from the central station managers in their locality, a much more valuable report can be made. We submit what has been done, trusting that it may prove useful and that it may be elaborated and improved if found of sufficient value to central station managers to warrant their more complete and careful co-operation.

Mr. W. R. Gardiner: I consider a paper of this kind of very great importance to central managers. In this paper the committee have gotten down to facts—there is no theory or fancy. It is made up of reports received from central stations, and is worthy of careful study. The principal items of information given us by the reports are the equipments of the stations represented and the number of watts produced per pound of coal. I think it would be well that the valuable work of this committee be extended so as to give us other items that enter into the cost of developing energy, aside from that of coal. To give you an idea of what I mean, I will, with your permission, read to you the result of a test that has been made under my direction.

First, which I will call cost of steam (coal and water only).

Second, which I will call cost at throttle of engine. The above and wages of firemen, repairs of boilers, interest on boiler room investment, fire and boiler insurance on same, depreciation on boilers, which I have allowed at 5 per cent.

EQUIPMENT.											PRODUCTION.									FUEL.			
	ENGINES.		BOILERS.		DYNAMOS.		ARC CIRCUIT.				INCANDESCENT.				POWER.								
No. of Report.	Class.	Water Consumption per H. P.	Class.	Evaporation per Pound of Combustible.		Efficiency.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Average Amperes.	Average Voltage.	Hours Run.	Total Watts.	Readings Every Min.	Total Watts from all Circuits.	Whole Amount of Coal used in One Day.	Watts Produced per Lb. of Coal.	Kind and Grade of Fuel.
22	A .	17	A	9 37	Multipolar.	85					7670	124.9	24	22,967,952					30	22,967,952	87.358	262	½ Soft Coal, ½ Hard Screenings.
1	B&F		C&D		Con & Bipol.		10	8145	24	1 954,800	224	1140	24	6,128,640	50	500	13	325,000	60	8,408 440	46 700	180	Hocking Screenings.
9	B		C		Multi.,Alt.,&c.		10	2387	13	5,896,081			24	2,434,500		500		2,322,750		10,653 331	59,884	177	Run of Mines, Alabama.
15	F		C		Arc, Alt.		6.8	47	4	1,278	66 4	1010	15	67,064						997,238	5,460	182	George's Creek, Cumberland.
8	E	27¼	C		Alt. & Con.		10	1000	12	120,000	37	1100	13	529,100					15	649,100	3,700	175	Cumberland
18	B X F X	32 7	C	11 3	Alt & Con		6 7	7000	8	355,144	7 05	1172	24	1,983,024	42.4 80 3 65 2	1142 325 548 2	23¼ 10 16½	1,125,765 260,170 589,743	15	4,313,846	24 750	174	Pennsylvania Soft Coal.
12	B		B	8 4	Arc.		9.5	48	14	10,552,752										10,552,752	62,000	170	Soft Coal.
2	B E Z	15 5	A		Various.		9¼	4800	12	6,600,000	150	2200	24	7,920,000		250 525	24 18	908,200 400,000	10	15,878,250	50 tons	158	Slack and Nut.
16	E		C		Arc, Alt.		by	Meter.		246,000				580,000				948,000		1,774,000		150	Pocahontas, Soft.
13	C X	24	C	10 5	Various.		6 8	2275	14	7,042 426										7,042,426	50,238	140	Babylon Pea.
10	B F	23 6	B	11 34	Alt., Bipolar.		9.8	50	12	1,817,256	137	1130	24	3 715,200	36	535	24	465,000	30	5,997,456	45,000	133	Illinois Washed Pea
21	C X		A C		Alt., Bipolar.		6 8			1,779,051	37		16½	837,930			10½	190,000	30	2,806,981	21,203	132	George's Creek, Cumberland.
17	B E		C		Alt., Bipolar.		6 8		7	357,000	40	1200	14	672,000					60	1,029,000	8,000	128.6	Coaldale, Bituminous.
19	F		C		Alt.		6.8	1100	5¼	43,010	27	1100	7½	Meter, 224,400					60	267,410	2,200	121	Pocahontas, Cumberland.
3	A Y	18	C	8 8	Alt., Bipolar.		10	Meter.	24	1,990,000		Meter.	24	90,900			24	950,000		3,849,000	35,322	108	Michigan Run of Mines. Poor.
20	F		C	9.02	Various.		6 8	6500	8⅓	367,333	100	240	16	384,000						845,333	8,131	104	Cumberland and Hard Scr'ngs.
14	A				Various.						6000	116	24						15	16,704,000	164,000	100	Buckwheat, No. 1 and 2.
4			A		Various.		10	3472	24	833,250	339	117.5	24	3 823,600	23	1060	24	584,640	15	5,241,500	60,283	86	Illinois Lump and Nut.
7	F		C	7.68	Alt.		6.8	1150	7¼	56,840	24	1040	7¼	105,560					30	162,400	1,963	83	Second Youg'y, Nut.
6	F		C		Alt.		6 8	656¼	8	35,700	16.75	2000	8	268 000	5	3916	6.5	127,269	30	530,996	6,583	80	Indiana Slack.
5	G X		A		Con. & Mult.						180	116 6	24	2,016,000						2,016,000	25,600	78	Illinois Nut.
11							10	50		1,500,000	104 140	120 1100	24 24	3,700,000 299,000	32	550	14	509,850		6,008,850	86,750	69	Soft Slack.
23	B E X		A								160	1000	16	1,640,000					30	1,640,000	42,000	44	Indiana Block.
24	F		C	6 3	Various		10	50 ea.	12	1,104,250	112	1120	12	1,505,280	45	223 5	18	181,035	30	2,790,565	79,800 11,900	30	Bituminous Pea. Bituminous Slack.

EQUIPMENT.

CLASS A. Boiler Room: Horizontal Water-tube boilers; feed through heaters by steam or power pump; hand firing. Engine Room: Triple Expansion Condensing Engines. Dynamo on Engine Shaft.

CLASS B. Boilers Vertical Water-tube; economizers, feed as A. Hand firing. Engines, Corliss Compound Condensing, belted to jack shaft.

CLASS C. Boilers, Horizontal Tubular, feed as A. Engines, Simple Corliss or slow speed, condensing, belted to jack.

CLASS D. Boilers, Upright Tubular; feed as A: Engines, Simple Corliss, Non-condensing.

CLASS E. Engine, High Speed Compound Condensing, belted direct.

CLASS F. Engines High Speed Simple Non-condensing, belted direct.

CLASS G. Engines, High speed Compound Non condensing.

REF. X. Any of the above non condensing.

REF. Y. Belted to dynamo.

REF. Z. Dynamo on the Engine shaft.

TABULATED REPORT OF COMMITTEE ON DATA.

Third, which I will call cost at the switchboard. The above and wages of engineers, dynamo tenders, mechanic and wiper, repairs electric plant, oil and waste, interest on steam plant, interest on electric plant, interest on real esiate, insurance on entire building and contents.

Fourth, which I will call cost at the lamp or motor without depreciation. The above and general salaries, office expenses, cost of carbons, globes, insurance, interest, incidental expenses, incandescent lamps, law expenses, oil and waste, repairs steam, repairs electric, repairs lines, taxes, wages wiring and wiring supplies.

Fifth, which I will call cost at the lamp or motor including depreciation, on total investment, which I have placed at 5 per cent. This does not include drop in the lines from station to lamp or motor.

Taking the fifth, cost at the lamp or motor including depreciation, as the total cost, I find that the cost of steam is 33.8 per cent of the whole.

That the cost at throttle of engine is 68 per cent more or 45.6 per cent of the whole.

That the cost at the switchboard is 26.4 per cent more or 67 per cent of the whole.

That the cost at lamp or motor without depreciation is 15.7 per cent more or 82.7 per cent of the whole.

That the cost at the lamp or motor including depreciation on investment, but not including any drop in line, is 17.3 per cent more or 100 per cent, the original total cost.

I should have been very glad to give you exact figures in dollars and cents. I have arranged it on the percentage basis. You will see by this report that the item of coal and water represents one third of the entire cost of develop-energy at the station, and I presume that this is the case with most of the stations situated at a distance from the coal supply. If this is the case, how important it is that we should know the best kind of coal for us to buy, as most of you are probably aware the price of coal is no sure indication of its value as a water evaporator. I have tested many kinds of coal and have found the evaporative power to be anywhere from 8 to 13.7 pounds of water per pound of coal. I have found the Pocahontas coal of Virginia, which is the coal that the builders of the government gunboats use on their trial trips, is undoubtedly the best. I find it the case in a great many stations and in most of the manufacturing plants that they depend almost wholly on the say of the engineer or fireman as to whether the coal they are using or some other, is satisfactory for their purpose. I think this is a mistake. We got two loads of coal which our fireman said was good coal, but the result of the test was 9.7 as against 11.3 with our regular coal; which shows the value of depending on the fireman with regard to the question of the evaporative power of coal.

The discussion of this report was followed by a paper by Mr. L. B. Marks on "Arc Carbons and the Rating of Arc Lamps." This paper brought out the great difference in carbons and was accompanied by a table showing the range in voltage between the hissing and flaming points with a large number of carbons. The carbons used in the tests were selected from those of various American manufacturers. Attention was called to the necessity of testing the carbons by the manufacturer as regards the current necessary to their best efficiency. The author believes the measurement by watts of arc lamps as adopted by the resolutions of the association to be the correct method and that central station manager will have less trouble if he sells his lamps at 450 watts than at so many candle power. The watts consumed by the lamp are easily determined;

the candle power may always remain an open question. The committee on standard rules for safe wiring reported that slight changes are reported in present rules and that a joint meeting will be held in the near future of the underwriter, street railway telephone and other interests which it is expected will result in much good and which will enable a more satisfactory report to be made at the next meeting.

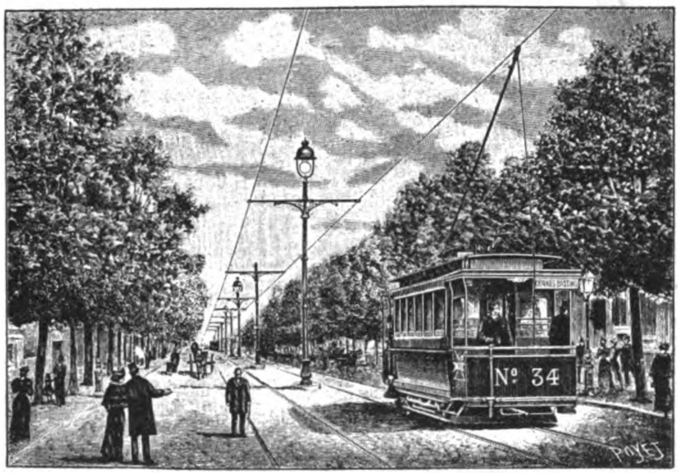
THURSDAY AFTERNOON SESSION.

The time of the association on Thursday afternoon was taken up with an executive session at which business matters of the association were considered. The election of officers also took place and the appointment of the executive committee. The officers for the coming year are: President, Mr. C. H. Wilmerding, Chicago, Ill.; first vice-president, Mr. Frederick Nicholls, Toronto, Canada; second vice-president, Mr. E. F. Peck, Brooklyn, N. Y. The members of the executive committee are: Messrs. E. H. Davis, Williamsport, Pa. (one year), W. R. Gardener, Pittsfield, Mass.; George A. Redman, Rochester, N. Y.; and J. J. Burleigh, Camden, N. J.

The association adjourned from this session to meet in May or June, 1896.

The Overhead Trolley in Cities.

The recent attempt to introduce the overhead trolley in London was opposed by many whom it would seem should have been its warmest advocates. One claim of these opponents of the overhead trolley was that it spoiled the looks of the streets, which is also one of the main arguments of the residents of certain streets in Chicago. An examination of the streets where the overhead trolley has been introduced using the center pole construction would show that such views are false. The neat ornamental poles and careful hanging of the trolley wires, with the feeder cables underground, in no way destroys the pleasant appearance of the street. The overhead work is so light and occupies so little room that it does not shade the street nor interfere with the lines of trees on each side. Streets in which the overhead trolley has been introduced do not hesitate to grant further privileges for the erection of trolley lines. The accompanying illustration taken from the Electrical Review shows a style of construction proposed for the streets in London, and, as will be noticed, it is similar to that in use in many American cities.



THE OVERHEAD TROLLEY IN CITIES.

The Hammond, East Chicago & Whiting railway, which was illustrated and described in the July, 1894, issue of Electrical Industries, has recently doubled the equipment of its power station. A new engine and Westinghouse power generator have been put in.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

17. *How does static electricity show itself?*

By the attraction or repulsion between charged bodies. When static electricity is discharged, it causes more or less of a current, which shows itself by the passage of sparks or a brush discharge; by a peculiar prickling sensation; by a peculiar smell due to its chemical effects; by heating the air or other substances in its path: and sometimes in other ways.

18. *Is any special or costly apparatus needed to detect static electricity?*

It is, if one wishes to make very accurate and delicate measurements. But much can be learned by very simple and cheap means.

19. *What are some easy ways of producing and showing the effects of static electricity?*

Rub a dry sheet of paper with a piece of dry cloth or with a coat sleeve, and the paper will stick to a table or to the wall for some time.

Pass a rubber or celluloid comb through your hair on a dry or cold day and the hair will stick to the comb. If it is quiet one may hear a slight snapping noise. The ends of the hair will also stand out as if they repelled one another. If it is dark, one will sometimes see small sparks from his hair, like the sparks from a cat's back.

By shuffling across the carpet on a cold, dry day, and then touching another person or a gas or water pipe, a spark will pass from him and he will get a shock at the same time.

20. *How can one make a cheap instrument for studying static electricity?*

By hanging a small bit of pith or feather on the end of a fine silk thread, or a fine hair, several inches long.

21. *What is such an apparatus called?*

An electroscope, because it enables us to see whether a body is electrified or not.

22. *How is the feather electroscope used?*

If an electrified body is brought near it the feather will be attracted. If the feather touches it, it will soon be repelled and fly away.

How can a body become electrified?

In any of the ways mentioned in A 16. A convenient way is to rub a stick of sealing wax with a flannel cloth; or rub a piece of dry paper upon one's coat.

23. *How can a more sensitive electroscope be made?*

Take a dry bottle with a wide mouth; push through the cork a piece of wire, the lower end of which is bent so as to form a square hook; upon this hook, hang a strip of ordinary gold leaf (which may be obtained from a dentist or at a bookstore), in such a way that the two ends are of the same length and hang flat and close together; place the cork in the bottle and adjust the wire so that the gold leaves do not touch either the sides or the bottom of the bottle. If the electroscope is charged by touching the wire with some substance that has been previously charged, the two gold leaves stand apart as if repelling one another.

24. *What can be learned from the gold leaf electroscope?*

It will show whether a body is electrified; it will indicate to some extent how much charge it has; it will also show whether the charge is positive or negative.

25. *What is meant by a positive or negative charge?*

With the feather or pith-ball electroscope it is noticed that the feather is at first attracted to the charged body, and is then repelled from it. If one charges the gold-leaf electroscope with a rubber comb that has been rubbed with a dry cloth, the leaves will stand further apart if the rubber is brought near the wire again; but if the rubbed part of the cloth is brought near, the gold leaves come closer together. When dry hair is dressed with a rubber comb, the hairs are attracted by the comb, but they stand apart from one another. This shows that when two substances are rubbed, both are electrified; but the charges are different. It also shows that bodies oppositely charged attract one another, but that bodies similarly charged repel each other. This is analagous to the law that like poles of magnets attract one another, while unlike poles repel.

26. *What is the difference between positive and negative charges?*

It is not definitely known. Many scientists have believed that there were two kinds of electricity; others believe that there is only one kind. If a body contains more than the usual amount, it is said to be positively charged; if it contains less than the usual amount, it is said to be negatively charged. A body is discharged when the positive and negative electricities come together and are neutralized. According to the other theory, a body is discharged, or neutral, when it contains neither more nor less than the usual amount. If electricity is a state of strain in the ether, a body is charged or not, accordingly as the ether in and about it is compressed, stretched or is neither.

27. *Can electricity be produced by rubbing any two substances together?*

Under some circumstances, yes.

28. *Does the same amount of rubbing always produce the same amount of electricity?*

No. It depends upon what substances are rubbed. Some are much more strongly electrified than others.

29. *Are some substances always positively electrified by rubbing, and others always negatively electrified?*

When any two substances are rubbed together, one of them is always positively electrified, and the other negatively. The same substance may be either positive or negative, according to the nature of the other substance. Different materials may be arranged in such an order that any one will be positively electrified if rubbed by any substance before it on the list, but negatively electrified if rubbed by any substance coming after it.

30. *Can static electricity be produced equally well by rubbing any two substances together?*

No. It is difficult to find any by rubbing metals together. The presence of moisture lessens the effects. Substances known as insulators become electrified easily, while those known as conductors do not.

31. *Why do not electrical conductors easily become electrified by friction?*

Because, as fast as the electricity is produced, it is carried away and becomes neutralized.

32. *What is the difference between insulators and conductors?*

Conductors are those substances in which electricity travels easily, while insulators do not furnish an easy path. There is no clearly marked line, since no substance is a perfect conductor, offering absolutely no resistance to the motion of electricity; nor is any substance a perfect insulator, absolutely preventing the motion of electricity. Different substances may be arranged in more or less definite order, with the good conductors at one end and with good insulators at the other end.

33. *Give a list of some common substances arranged in the order of their conductivity.*

1, silver; 2, copper; 3, other metals; 4, carbon, charcoal and graphite; 5, acids and salty solutions; 6, animals and plants; 7, pure water; 8, various oils; 9, cotton; 10, dry wood; 11, marble; 12, porcelain; 13, wool; 14, silk; 15, rubber; 16, shellac; 17, paraffin; 18, glass; 19, dry air.

34. *Do these substances always keep in the same relative order?*

No. Their conductivity is affected by various conditions, such as their purity, the presence of moisture and other causes.

Obituary.

GEORGE E. PREECE.

The death of Mr. George E. Preece, a brother of Mr. W. H. Preece, F.R.S., occurred on February 2nd at Colwyn Bay. He had been connected with the telegraph and cable service since early in life, having first been connected with the Electric and International Telegraph Co. in 1854. In 1861 he went to Malta in charge of the Mediterranean cables, and afterwards was employed in laying the cable from Florida to Havana. He assisted in laying many of the great ocean cables, and was one of the most experienced in the service. He was a member of several electrical societies and contributed many papers to these societies and to the technical journals.

Small Isolated Plants.

Several very complete equipments for isolated electric lighting have recently been brought out. These equipments are of a number of kinds and include everything necessary for the plant. Such equipments fill a want which has long been felt at summer and suburban residences for manufacturing establishments, etc. Equipments of this kind may be divided into four kinds as regards their power-generating equipment. Thus, for a plant of 50 16 candle-power lights we have the first, outfit A, operated by a six horse-power gas engine, outfit B operated by a six horse-power gasoline engine, which is equipped with tank and reservoir for water which is used for cooling the cylinder. Outfit C, which is operated with a six horse-power steam-engine and boiler. Outfit D, which is operated with a six horse-power windmill with automatic governor. The 50-light dynamo and switchboard furnished with the first three outfits are similar, but for outfit D a special dynamo and a set of storage batteries are furnished. All parts of these outfits provide reliable pieces of apparatus and are made as nearly self-regulating as possible. The outfits have been placed before the public by Mr. Alfred M. Walker, of 851 The Rookery, Chicago, who has had an extended experience in the construction of electrical and power apparatus.

The North Chicago Street Railway has started electric cars on a number of their lines.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Wrinkles In Electrical Practice.—II.

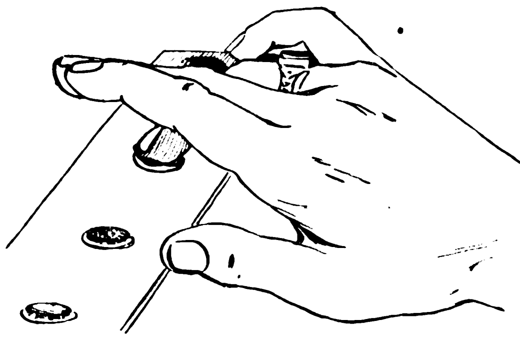
BY ALBERT SCHEIBLE, M. E.

Is the speed right? This is really one of the most important questions connected with the running of an electric plant, yet we rarely hear it asked by those in charge. Few station men seem to consider how much may depend on having the machines run at their proper speed. Yet they know that an increase of the voltage above the normal, caused by overspeeding the dynamo, will be harmful to the life of the lamps on the circuit. Or if we run a motor below its proper speed and still expect it to do its full rated work, it will consume an excessive amount of current, and this is apt to damage the motor armature. In either case a count of the speed may serve as a check on the voltmeter or ammeter readings and may often trace the trouble to the mechanical parts instead of leaving you to hunt for it in the electrical part of the outfit. There are a number of good speed indicators on the market, and most of these can be bought at so low a price that there is no good excuse for the lack of one in every well-equipped plant. But it sometimes happens that a record of the speed is wanted when no indicator is at hand and when it is more important to get an approximate count right away than to wait for some time and get the exact figure. Then if the speed is below 400 revolutions per minute you can use a little "wrinkle" in speed counting which will give results close enough for nearly all purposes.

Suppose you find a dynamo whose voltage is considerably below the normal, even with the field resistance all out. The generator and rheostat all seem to be in proper order, so it looks as if the trouble might be in the speed. But the engineer says that the engine is up to speed; he knows "she is running 360", and as he also knows that there is no speed indicator within several miles he dares you to disprove his word. I found just such a case some years ago and thought that the engineer must be mistaken in his judgment. So I took off my coat, and asked him to give me a sharp tap on the shoulder at the beginning and again at the end of a minute. In less than ten minutes I had taken three counts which, if I remember right, agreed quite closely and averaged about 341. Then after I had spent about half an hour in showing the engineer that after a little practice he would be able to do the same, I started off after a speed indicator. Three readings taken with this indicator averaged 343, or within one per cent of my count. I have since then used the same plan of counting under various conditions and in one case tried it for getting the speed of an engine, which had the end of the shaft so close to the wall that no indicator could be applied. No doubt it may also help out in many other places.

The "wrinkle" of counting such speeds lies in not trying to count from one up to fifty, or even up to twenty, but in counting by tens. With a little practice almost any one can count up to ten in a second and a half, and doing this forty times in succession means counting four hundred in a minute. Then all that is needed is some simple way of keeping track of the number of tens you have counted. I like to use the buttons on my vest for this purpose. I start the first ten with the thumb of my right hand on the top button; the moment I get to ten I slip the forefinger on the button and keep it there while I count the second ten; then I use the middle finger while counting the third ten, and so on. Then when the little finger has had its turn, I start again with the thumb on the second button. In this way each button which you have passed counts fifty, the fingers which have already had their turn on the last button count ten each, and you merely have to add the odd digits which you had just counted when the minute was up. Thus let the cut show the hand at the seventh button, and suppose the minute was up just as you counted "eight". Then the six buttons already passed mean fifty each; the three fingers which have had their turn count ten each and you have the eight digits to add, making the count 338. Of course if there are not enough buttons on your vest you can start at the top again after reaching the foot.

In speeding an engine by this plan you can generally rest your left hand on a stick, held against the engine cylinder, so as to feel the thumps and count these instead of depending on a glimpse of the crank every time it comes around to a certain position. Of course a good speed indicator is the proper thing to have in every station and its frequent use may save both expense and annoyance. But there are times when you may want to count a moderate speed without having an indicator at hand or (as in the case of a shaft set too close to the wall) where no indicator can be used. Then such a "wrinkle" as the above will be worth knowing.



WRINKLES IN ELECTRICAL PRACTICE.

Storage Batteries and Their Construction.

BY J. K. PUMPELLY.

Although the action of the storage battery, or accumulator, as it is often named, has been a study for scientists for many years—in fact ever since Faure made them practically commercial to a certain extent, anyone of intelligence and some share of ingenuity can, with a few directions, make a storage cell that will in many particulars do the same kind of work as one made by the most experienced of battery makers. Any boy who takes two sheets of lead and immerses them in a vessel filled with a weak solution of sulphuric acid and water, keeping the lead apart, connects one piece to the positive pole of the dynamo, or, in fact, any source of sufficient electrical energy, and the other piece to the negative pole, and allow a slight current of electricity to pass from one lead to the other through the liquid, thereby decomposing the water in the solution, will after a time form a storage battery which will give out electrical energy just in proportion to the amount of electrical energy put into the solution, or rather in proportion to the chemical energy excited in the solution, which chemical energy shows itself in changes produced on the surface of the two pieces of lead. The water is decomposed by the action of the electrical current into oxygen and hydrogen; and if the surface of the lead happens to be in a porous or partly granulated condition the lead at the negative pole will absorb hydrogen just in proportion to its porosity or fineness of the divided particles, and the lead at the positive pole will be converted by the more active oxygen in proportion to the length of time it has been acted upon by the generated gas.

The energy excited in the discharge of the cell may be of several kinds: It may show itself in light; it may produce heat or motion, each and all depending upon the medium by which the flow or passage of this accumulated energy is opposed; in fact, the kind of resistance that is put in the way of its direct passage.

Now, since the amateur battery-maker, who is intelligent and observant, and has to aid him sufficient knowledge of chemistry to draw conclusions on what he sees in the action of his first battery, will find where and how to improve when he learns that the oftener he charges and discharges his two plates the more efficient they become—that is, he gets in the discharge a greater percentage of energy or work for the energy expended in charging; then he begins to call ingenuity to his aid, and does some mechanical work as well as chemical work. He studies how to put the lead pieces in such a shape or condition that they may move easily and rapidly be acted upon by the gases set free in the process of charging. He seeks to make his negative plate more spongy, so that more atoms of hydrogen may be readily absorbed, and his positive plate in a mechanical condition most easily acted upon by the oxygen evolved.

Reasoning in this way Faure himself, when still new in the business—about where our bright boy amateur would be today—said to himself, why not use powdered lead, or lead in some form finely divided, and putting that on my lead plates, start so much ahead of where I was at first. Faure finds that the ground red lead in the market or litharge used in paint will serve this purpose. This he tries, finds it works well in its chemical action and saves many hours of charging; but mechanical difficulties stand in his way. He finds it almost impossible to make these applied forms of finely-powdered lead remain on the plate. Now, it is a fact that mechanical methods to overcome this one difficulty has excited the ingenuity of many men and much scientific experimenting for over twelve years, and absorbed hundreds of thousands of dollars.

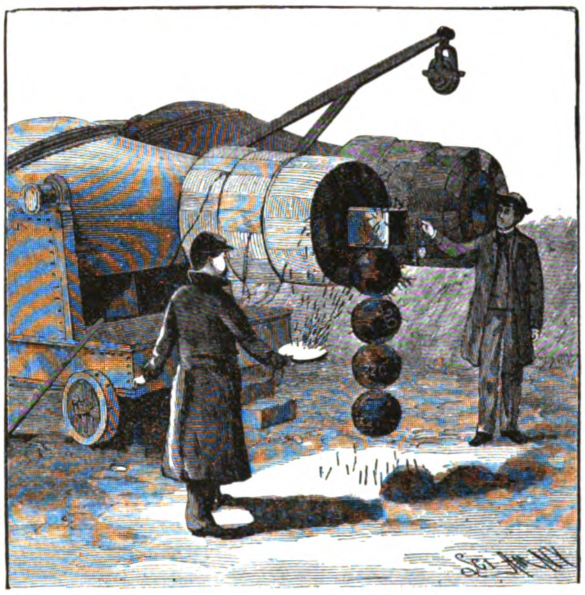
Today chemistry has been more thoroughly drawn upon, and the action of acids and alkalies upon lead more thoroughly studied, so that instead of striving to force finely-divided or powdered lead into holes or receptacles in a lead plate, the lead plate itself is rapidly acted upon first, and so prepared to take more readily the chemical changes in charging so necessary for efficiency in the discharge. This process is, in fact, going back to first principles, used by Plante, the first inventor of an efficient storage battery. The results of his process were obtained by long and tedious processes, whereas now the better understood application of electric chemistry in its action on lead hastens the forming of what is called a Plante plate from 60 days of constant charging and discharging to half the number of hours.

The electro-chemical process being now quite rapid and successful, the mechanical construction of the plate itself is the great aim of the manufacturer.

The description of this art, which has taken many and varied forms, would occupy too much space for this article, and is worthy of another paper. The reader or the experimenter may consider this as merely an introduction to a more extended article on storage battery construction.

Cannon Magnets.

We reprint from the Scientific American an illustartion of Col. King's great magnet, made several years ago at Willetts Point fortification. The magnet core consisted of two old Rodman 15-inch guns, weighing 50,000 pounds each. It was turned into a club-footed magnet by the addition of many tons of heavy iron plates. The coil consisted of old torpedo cables 14 miles long, carrying 20 to 25 amperes. The armature consisted of 6 platform plates bolted together. A calculated force of 44,800 pounds was insufficient to tear off the armature, the chain used being broken by the strain. Five cannon balls, of 325 pounds each, were suspended like a chain from the muzzle of the gun. An iron spike placed against the breast of a man standing three or four feet off, with his back to the gun, stood out straight. It required the efforts of two men with a sudden jerk to pull away a 25-pound bar from the gun. The entire mass of iron, including guns, carriages, armature, etc., weighs over 130,000 pounds. At a distance of 71 feet the magnetism of the gun equaled that of the earth, a compass needle being deflected 45 degrees; at a distance of 300 feet it was deflected 3 degrees.



CANNON MAGNETS.

One of the first roads constructed on the Beecher single railway system is to be constructed between Lakeside Park and Waterport in Orleans Co., New York. This section is four miles long and will be extended as the advantages of the system are demonstrated on the short line. The company owning this line is the Waterport Light, Power & Railroad Co., while the construction is done by the Equipment Construction Co. of Batavia, N. Y. In this system of railroad the roadbed consists of a single T rail and two guide rails eighteen inches apart horizontally, beneath it. This structure is mounted on 14x14 inch posts and is 12 feet high in the clear except over highways and railroads where it is higher. The motor cars will be equipped with Johnson's motor operated from storage batteries. Water power at Waterport will generate the electricity for charging the batteries.

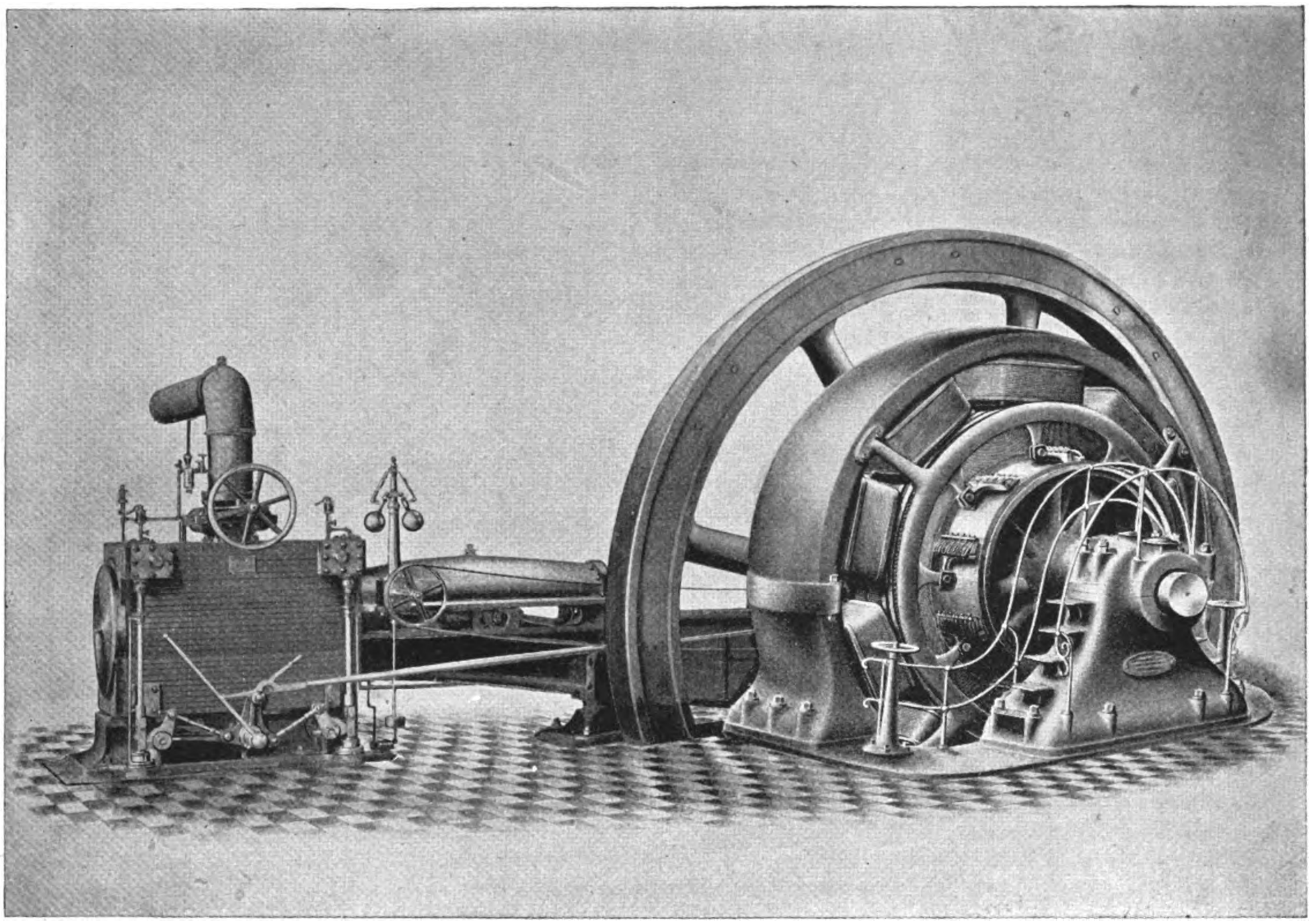
NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

Large Direct-Coupled Railway Generator.

The time is past when electrical generators are looked upon as matters of experiment. In their design everything is accurately determined before a pattern is made; their strength and capabilities are fully worked out and no question remains to be solved when the machine is completed, except how accurately the workman has carried out the plans of the designer. Generators of large capacity are as easily constructed as those of small size. The accompanying engraving shows a generator of 1,000 kilowatts capacity, direct coupled to horizontal engine. The combination was designed for railway work and was built by the Walker Manufacturing Co. of Cleveland, Ohio.

The exacting requirements of railway service are fully understood by the engineers of this company and strong, easily regulated generators have been the result. All experimental features and novelties have been avoided and only the well-established lines have been followed. The many details that go to make up a dynamo electric machine have been moulded into a well-rounded, symmetrical whole and neat, substantial outlines give the machines a good appearance. In the large generator here shown the lines followed in the smaller machine have necessarily been somewhat modified and many details have been added, as the occasion demanded. The large size of the frame has required a modification of its method of construction. The construction that gives the best magnetic efficiency has not been lost sight of. For the support of the brush holders and regulating apparatus a frame has been added as the increased number of brushes demanded. By the method used the brushes are held against the commutator in such a way that the "chattering" and "singing" of the brushes is prevented.



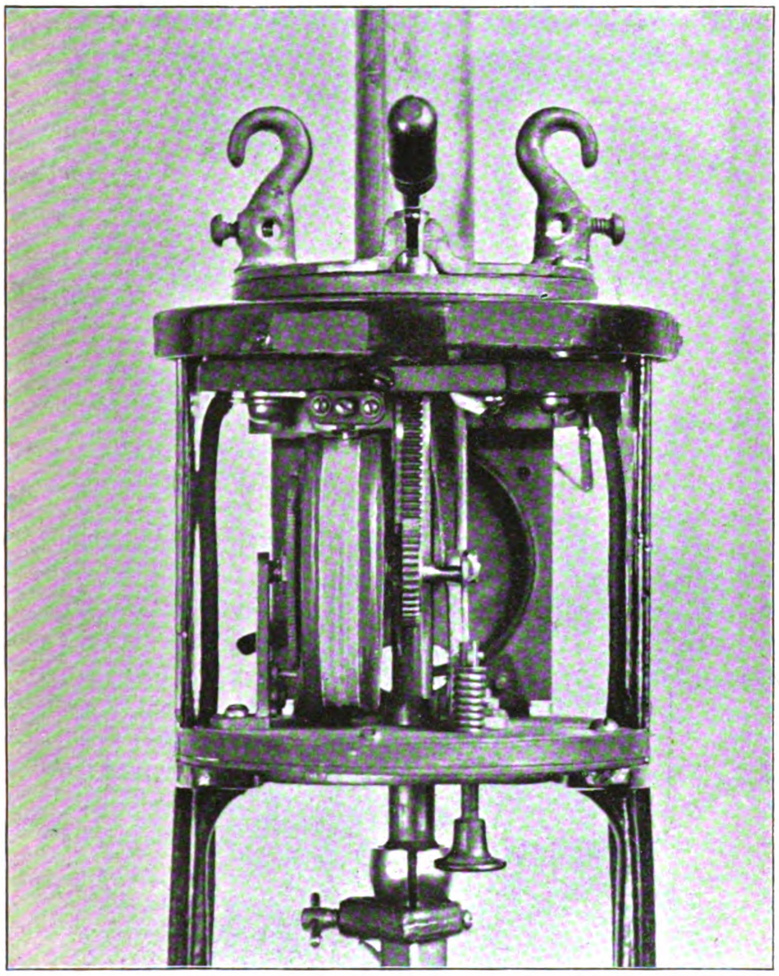
LARGE DIRECT-COUPLED RAILWAY GENERATOR.

The armature is of a large size, of the iron-clad type, well ventilated and is of low resistance. The windings, which are of copper bars bent to shape, have no joints except at the commutator. The insulation has been most carefully perfected. The insulating material used is a combination of mica, with a fibrous material of great toughness and durability and withstands a test of 5,000 volts, alternating. The shaft supporting the armature is large in size, held in broad and long bearings, which reduces the pressure per square inch of surface and gives a large cooling area. The bearings are of the self-oiling type and run cool. The pole pieces are made of soft laminated iron and the coils are machine wound.

The works of the Walker company at Cleveland are exceptionally well equipped for the production of heavy machinery. The extensive shops from which heavy machinery has found its way to all parts of the western hemisphere has long held a high reputation for the production of cable and other railway equipments. The electric railway motors, as well as power-house apparatus, are being used in a large number of cities and its reputation is growing rapidly. The accompanying engraving clearly illustrates one type of railway generator built by this company.

The Wax Wheel Arc Lamp

A year or two ago a decided departure was made in the construction of arc lamps by the introduction of what is now known as the wax wheel lamp. In the operation of this lamp a "heat movement" is used for the feeding mechanism. The construction of the feeding mechanism is shown in the accompanying engraving. Between two ebonite discs is mounted a ring of wax-like material. The wheel thus formed is supported on a shaft, which is geared to the rack on the upper carbon rod. On a stationary holder is mounted a metal pin in such a manner as to have one end embedded in the wax ring one-eighth or three-sixteenth of an inch. Around the upper end of this pin there is wound 150 ohms resistance of German silver wire, the remaining resistance in series with it, being from 600 to 1,000 ohms.



THE WAX WHEEL ARC LAMP.

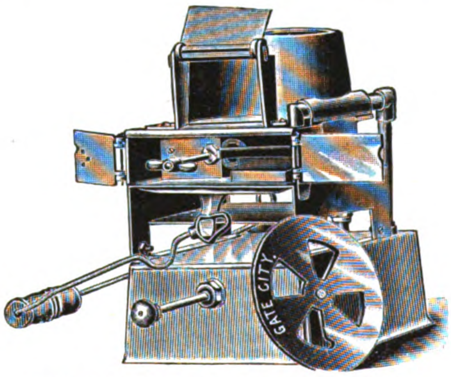
With the pin embedded in the wax it is evident that the upper carbon rod will be held rigidly in place. As the carbon rods burn off and the ends become farther apart, a part of the current will pass through the shunt circuit. The current passing through the fine wire wound around the pin heats the pin which melts the wax around its point. The wheel is allowed to turn slowly, owing to the weight of the rod to which it is geared. This movement is so slow and uniform that it is practically impossible to detect any movement. The disc makes but five revolutions to the length of the rod.

The melted material of the wheel solidifies immediately after the passage of the pin, leaving a smooth surface. The composition of this wax is a combination of a number of substances, that, when combined, produce a material which, when heated, does not go through a plastic or semi-melted condition, but is either solid or a liquid. The discovery of this material was one of the most important things in connection with the invention of this type of lamp. The pin is made of silver, because of its heat conducting and non-corrosive properties. In considering the effect of the current in producing heat it is well to remember that the heat developed in a given resistance varies as the square of the current. Thus the longer the arc the greater the current through the shunt. A slight variation in the length of the arc makes a large difference in the heat at the silver point. The lamp is exceedingly sensitive, therefore, and the feeding is continued in such minute steps that it is almost imperceptible.

The entire mechanism of the lamp is exceedingly simple and the train of gears, dash pots, magnets, clutches, etc., found in the other types of lamps are entirely absent. The mechanism of this lamp is equally adapted to either constant current, constant potential or alternating current circuits. They may be operated from any type of dynamo. The lamp is manufactured in a number of styles to meet the different conditions of service. The lamp which, as shown, is exceedingly simple in every detail, has by that very fact required a large amount of time and study to bring it to its present state of perfection. It was invented, and more recently perfected, by Mr. S. E. Nutting. The lamps are manufactured by the Nutting Electric Company, Chicago.

The Gate City Soldering Furnace.

One of the most important articles used in electrical work is a soldering furnace. To meet the demand for a substantial furnace adapted for this work Messrs. Nicholas & Barr have brought out the Gate City soldering furnace. This furnace is shown in the accompanying illustration, which gives an excellent idea of its interior. The fuel used is gasoline, and the furnace can be used in all kinds of weather without the fire being extinguished. It can be regulated to almost any degree of heat and can be used for melting lead or paraffine, for heating soldering irons or for heating joints of pipes. The pressure pump is fixed, which is a great improvement over the old fashion bulbs. The burner is of a new design, which gives a perfect combustion and the best economy in the use of the fuel. It is being used not only by the conduit, electric light and telephone workers, but also by tinners, plumbers and other tradesmen. The furnace is simple in construction and operation. The burner does not clog up. It is placed on the market by Nicholas & Barr of 28 W. Washington street, Chicago.



THE GATE CITY SOLDERING FURNACE.

New Bryant Specialties.

The two specialties illustrated herewith have recently been brought out by the Bryant Electric Co. of Bridgeport, Conn., to meet a demand of the trade. In Fig. 1 is shown an angle receptacle, which gives the lamp an angle of 45 degrees with the wall. Its special advantages and the many places in which it meets special requirements will at once occur to construction men. It throws the light in a direction most desired in offices, libraries, etc. Where fitted with a fancy shade it is very ornamental in appearance and produces a much neater effect than any of the ordinary sockets.

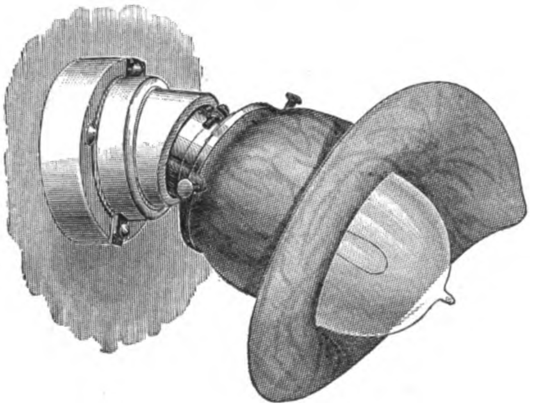


FIG. 1.—NEW BRYANT SPECIALTIES.

The base is constructed so that fuse wires may be used, if desired. It fits closely against the wall and is easily put in place. This receptacle is already being used by the trade, and it seems to fill a place among the standard supplies. The company has also placed on the market a new waterproof socket, which is being used for exterior and decorative lighting. The main portion of the socket is constructed of porcelain of the same quality that is used in all the goods of this company. The wires enter the base and connection is made with the contacts of the socket within the base. When the lamp is in place there is no part of the conductors exposed. All are concealed within the weather-proof covering. Screw holes are provided at the sides of the base, by which it is fastened in place, either with screws or bolts.

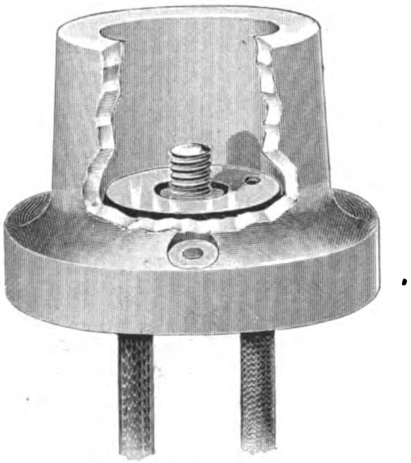


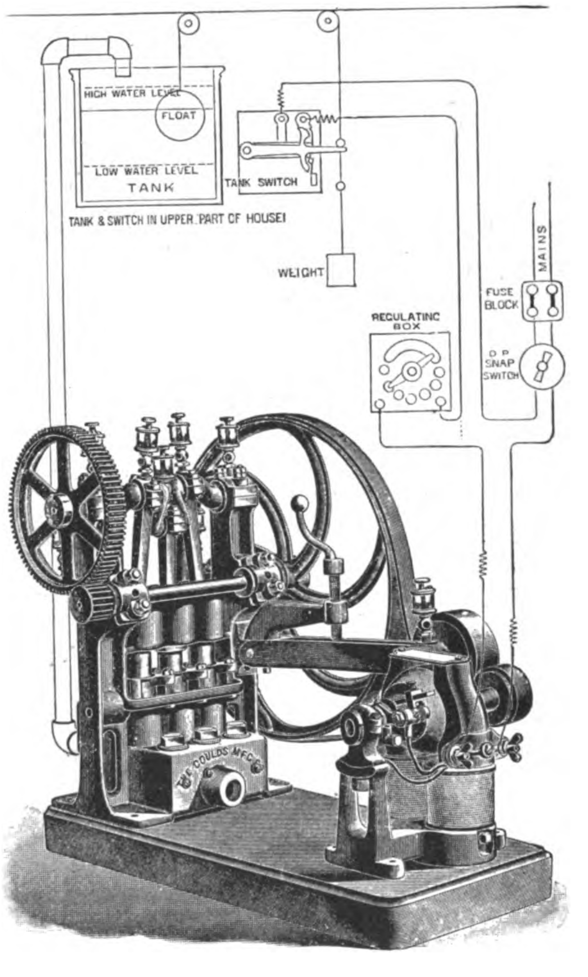
FIG. 2.—NEW BRYANT SPECIALTIES.

The city lightning plant at Alameda, California, is nearly completed. The rates charged customers for incandescent 16 candle-power lamps range from 85 cents for 10 o'clock lights to $2.25 for all night lights per month. Arc lamps range from $8 for 10 o'clock to $12 for all night lights. Current is also sold by meter at 20 cents per thousand watts.

Method of Controlling Electric Pumps for Reservoirs.

A very simple method is used for controlling the flow of water to reservoirs from pumps operated by electric motors. This method is modified as occasion demands, but the method here illustrated is that commonly used by the Goulds Manufacturing Co. of Seneca Falls, N. Y., in connection with their pumps for this purpose. The necessity of some such device is evident upon a study of the usual arrangement of such pumping systems. In many of our large cities the pressure on the water mains in the streets is not sufficient to force the water above a few stories of the large buildings, and in order to accommodate tenants of the other floors it is necessary to install a private pumping plant.

The introduction of the electric motor and the lines of supply circuits, which reach almost every part of the cities, has made the installation of such plants a simple matter. The place usually selected for the location of such plants is in the basement, as much out of sight as possible. While the motor and pump are located here, the tank to which the water is pumped is located in the upper story or upon the roof of the building. It is thus impossible for one person to watch both parts of the system, and the ingenious arrangement here shown has been devised by which the automatic regulation of the supply water is effected.

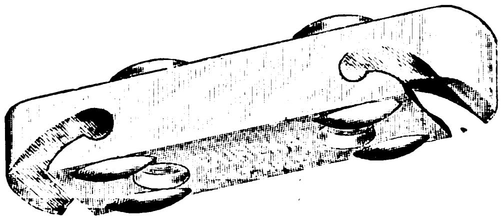


METHOD OF CONTROLLING ELECTRIC PUMPS FOR RESERVOIRS.

The supply wires, or one of them, are run to a point near the tank, as illustrated, and a switch placed in them, which is opened and closed as the float on the water rises and falls. The operation of the motor and pump is limited to that absolutely necessary to keep water in the tank. The entire attendance required by the plant is that of oiling and cleaning the wearing parts. The pump shown is a Goulds triplex, adapted for electric power.

A New Cleat.

New cleats have been brought out in a great many styles this season but the one illustrated herewith has attracted attention on account of its simplicity. By an examination of the illustration it will be seen that Wood's Eureka porcelain cleat has a slot parallel with the wire and will allow the wire to be pulled taut before being placed in the slot. It requires but a slight side motion to pull the wire down to the bottom of the slot. A slight bend in the slot holds it firmly. The wire can be placed in the cleat while under tension and there is no danger of slack wires. Its simplicity, ease of installation and perfect insulating qualities are its prominent features. It is manufactured by M. M. Wood, 1536 Monadnock Blk., Chicago.



A NEW CLEAT.

The B. & L. Railway Line Devices.

There are many of the smaller devices and appliances used on the electric railways that are easily constructed in an ordinary shop. The castings can be cheaply made at a foundry and the balance of the work is done at odd times, when workmen would otherwise be idle. With a view to making this work comparatively easy, Messrs. Butterworth & Lowe of Grand Rapids, Mich., have brought out a line of trolley cars, hangers, pull-offs, etc., which are easily constructed in the above manner. Patterns for the castings are furnished, with full specifications, by this firm to railway companies.

The devices are very simple, with few parts and little work is required to fit them up. The trolley car requires a thread turned on the shank, a hole drilled and tapped for a small screw. The wood insulator can be procured of any wood turner or can be turned in the shop. The trolley car is constructed so as to form its own hinge, and after the screw is tightened up the wire is held firmly in the jaws. After it is in place it can be removed at any time, as the screw is of brass and will not rust. Persons familiar with line work will appreciate the simplicity of the device and the ease with which it is attached to the line.

Repair work is quickly effected. The pull-off requires but one hole drilled and has the same claims to simplicity as the ear described above. These devices are in use by the Consolidated Street Railway Company of Grand Rapids, where they are giving very satisfactory service. The first instance where a hanger has had to be replaced has yet to occur. The small royalty paid for the use of these devices is based on the number of miles of road operated. The devices are worthy of investigation by street railway men.

One of the heaviest expenses which the street railway, the northern city has, is the removal of snow and ice from the streets. The expense to the West End railway of Boston for this item, is between $200,000 and $250,000. To clear the tracks of snow after a heavy snow storm is heavy expense, and every man available is pressed into service.

CONVENTION NOTES.

The Weston Electrical Instrument Co. had its interests well cared for by Messrs. Heinrich and Shain.

The Sunbeam Lamp Manufacturing Company, Chicago, had its interests well taken care of by Mr. F. S. Terry.

The Cutler-Hammer Mfg. Co., Chicago had a display of rheostats which was in charge of Mr. H. H. Cutler.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., was ably represented by Mr. H. Hine and J. F. Kelly.

J. Holt Gates, of Chicago, managed to leave his business for a short time to shake hands with his many friends at the convention.

The Chicago Rawhide Mfg. Co., Chicago, had literature on rawhide products distributed, illustrating their use for power transmission.

The Washington Carbon Co., Pittsburg, Pa., was ably represented by Mr. J. S. Crider, J. S. Humberd, L. W. Washington and others.

The W. S. Hill Electric Company, Boston, exhibited parts of the well known Hill switch. Mr. C. H. Merrick well represented the company.

Mr. M. M. Wood was present to represent his electric light and railway specialties and also had with him a model of his new Eureka porcelain cleat.

The Faries Manufacturing Company, Decatur, Ill., had in attendance its president, Mr. Robt. Faries, who distributed circulars descriptive of his incandescent lamp holder.

The Clonbrock Steam Boiler Works, Brooklyn, had its interests most carefully looked after by Mr. Morrin, the inventor of the boiler manufactured by this company.

The Western Electric Co. had a representative early on hand in Mr. C. D. Wilkinson, who well understands the duties of the convention delegate, and in which respect he is unsurpassed.

S. F. B. Morse & Co., the Chicago agents of Day's Kerite wires and cables, through their representative, Mr. S. F. B. Morse, took care of the interests of this well known brand of wires and cables.

Mr. Geo. Cutter had samples of his lamp supporting pulley; also his new arc lamp windlass, volt meter switch and a new soldering device for inside wiring. Mr. Albert Scheible was also present.

The Wallace Electric Co., Chicago, did not miss this opportunity of sending its representative men to keep the merits of their goods before the trade. Messrs. Wallace and Hine were both in attendance.

The Nutting Electric Co., Chicago, exhibited its wax wheel lamp, which was in charge of Mr. Carl MacFadden, who is well acquainted with the merits of the lamp, and was ready to explain them to his many visitors.

The Packard Electric Co. called especial attention to its exhibit of Packard transformers, in the construction of which many improvements have recently been made. Messrs. W. D. Packard and J. W. Packard were present.

The Phillips Insulated Wire Company, Pawtucket, R. I., exhibited samples of its well known brand of insulated wires and cables. Mr. H. C. Adams, of the company, was in attendance, and in every way took care of the company's interests.

The Crouse-Tremaine Carbon Company, Fostoria, O., exhibited electric light carbons and motor brushes, and was represented by Mr. J. B. Crouse, president, and Mr. H. S. Hart. The carbons shown compared favorably with imported carbons and attracted considerable attention.

The Electric Appliance Co., of Chicago, united with the well known manufacturing companies, the Packard Elec. Co. and New York & Ohio Co., in making a display of the standard line of goods for which the Appliance company is the headquarters in the west. President W. W. Low was present.

The Shawhan-Thresher Electric Co., of Dayton, O., had its interests well cared for by Mr. A. A. Thresher. The superior line of motors and dynamo manufactured by this company are becoming better known each year. The important plants that are now using them is sufficient evidence of their high quality.

The Buckeye Electric Company made a most elaborate exhibit of lamps in the hotel.

The Anchor Electric Company, Boston, exhibited samples, having in attendance its vice-president, Mr. Norman Marshall.

The Jewell Belting Co was well represented by Mr. C. E. Newton and Mr. C. L. Tolles, who had with them some interesting models.

Butler Mfg. Co., Chicago., was represented at the convention by the distribution of little pamphlets descriptive of their electrical specialties.

The Ball Engine Company, Erie, Pa., had its interests well taken care of by President D. N. McBrier and Vice-President D. N. McBrier, jr.

The Akron Insulator & Marble Company, Akron, O., had its interests well taken care of by Mr. A. L. Daniels, who had with him a number of samples.

The Union Brass Company, Chicago, was well represented by Mr. W. S. Bartholomew, who showed samples of the Mosher lamp made by his company.

The American Electrical Works had its interests well taken care of by Mr. P. C. Ackerman, of the New York office, and Mr. F. E. Donohue, of the Chicago office.

The Partick & Carter Company, Philadelphia, had its interests ably taken care of by Mr. E. Ward Wilkins, a popular member of this old and and well-known firm.

The Interior Conduit Co., New York, in connection with the Central Electric Co., Chicago, exhibited one of its multipolar, slow-speed Lundell generators recently put in the market.

The Sweet Electric & Manufacturing Company, Grand Rapids, Mich., made an exhibit of direct current and alternating current switches. Saml. Barnes, electrician of the company, was in attendance.

The Jenney Electric Motor Company, of Indianapolis, was represented by its president, Mr. Chas. D. Jenney. The new factory which the company is building, it is expected, will be completed soon.

The Crane Company, Chicago, had a display of valves among which were noticed aluminum valves and others of special design. The interests of the company were well taken care of by Mr. G. A. Hurd.

The Chicago Cross-Arm Company, Chicago, was represented by H. M. Angle, president, and Chas. S. Marshall, vice-president. The enterprise of the company was well shown in the circulars distributed.

Chas. A. Schieren & Company, New York, the well-known manufacturers of dynamo belting, made no exhibit but its interests are well looked after by Mr. M. A. Sullivan, who distributed circular, catalogues, etc.

The American Electrical Manufacturing Company, St. Louis, manufacturer of incandescent lamps, had its interests taken care of by the president of the company, Mr. Louis Nahm, and Mr. J. F. Gerleman.

The Indiana Rubber & Insulated Wire Co., of Marion, Ind., was well represented by General Manager Butler, who distributed a very neat and useful souvenir in the shape of Professor Robert's Wiring Slide Scale.

M. B. Austin, western representative of the Safety Insulated Wire and Cable Co., and Holmes, Booth and Haydens distributed safety watch-guards and problems for the amusement or torture of the mathematicians.

The Cummings & Engelman Conduit Company, Detroit, Mich., was well represented at the convention by its president, J. F. Cummings, who made many acquaintances and presented the merits of the conduit system, which the company is pushing with great success.

Mr. Chas. E. Gregory, of the Chas. E. Gregory Co., was on hand to talk business or pleasure as opportunity offered. He distributed a very neat souvenir presenting handsome engravings of the principal officers and stockholders of the company. The pamphlet also contained a very complete list of the light and power plants installed by the company to date.

The Metropolitan Electric Co., Chicago, while it did not make an elaborate display of its specialties, had its interests most ably taken care of by President W. H. McKinlock, who was kept busy renewing old aquaintances and making new ones.

The Walker Mfg. Co. had headquarters at the Hollenden and its works were open to visitors, many of whom availed themselves of the opportunity given to visit this large and interesting plant, which is now turning out electrical apparatus in handsome quantities.

The New York Insulated Wire Co. was represented both from the eastern and western offices. Mr. James Wolff, the Chicago representative, was ready at all times to talk Grimshaw wire. Messrs. Whitney and Kelly were on hand with the New York delegation.

The Okonite Co. was, as in years past, represented by the familiar and welcome faces of Capt. Willard Candee and Mr. Geo. Manson. It may be truly said a convention would hardly be a convention without these pleasant gentlemen to present the merits of okonite.

The Standard Paint Co., of New York was represented by General Agent Mr. F. DeRonde, Mr. J. C. Shainwald and Wm. Weierbach. A handsome souvenir was distributed by Mr. DeRonde in the shape of a card case, which was much appreciated by those fortunate enough to receive one.

The Hart & Hegeman Manufacturing Company, Hartford, Conn., made an excellent exhibit in the exhibition room in the hotel, which consisted of the well-known switches made by this company. Mr. Gerald W. Hart was present, together with Geo. S. Searing, the Chicago agent of the company.

The Central Electric Co., Chicago, made an excellent display of many of its leading and well-known specialties, including okonite wires and cables, interior conduit arc lamps, Lundell motors, etc. Mr. Geo. A. McKinlock, president of the company, was in attendance, accompanied by Messrs. Chas. G. Burton and P. B. Chaney.

Ft. Wayne Corporation occupied the parlor in the hotel and was well represented in every way. Vice-president Mr. C. S. Knight was in attendance, together with Philadelphia Agent Mr. G. A. Miller, New York Agent Mr. S. A. Douglas, Cincinnati Agent Mr. T. J. Ryan, Mr. Thos. Cooper, Colorado, and C. E. Wilson, Chicago.

The Eddy Electric Manufacturing Company, Windsor, Conn., had its interests well looked after by Mr. M. E. Baird. Mr. Baird did not make an exhibit, and, in fact, it was not necessary for the reason that the company is one of the oldest in the field, and Mr. Baird was equal to the occasion. The presence of Mr. A. D. Newton was greatly missed, but he found it impossible to get away.

The Brush Electric Company, Cleveland, occupied a parlor in the hotel, and was represented by Messrs S. M. Hamill, W. S. Rogers, L. N. Rogers, A. H. Hough, I. R. Prentice, A. D. Dorman and T. E. Adams. A very interesting historical exhibit was made by the company in the shape of its first arc light dynamo, built in 1876. Samples of the Brush Adams arc lamp were shown in the hotel.

The General Electric Co. had a supply of literature at its headquarters at the Hollenden, and an elaborate display of supplies and central station goods at the new power-house of the Cleveland Illuminating Co., where was also shown in operation the Monocyclic system, which provides for both light and power from the same alternator. The company had a large representation from its different departments.

Jas. J. Murray & Co., Philadelphia, had an extensive exhibit at their headquarters of electric fixture glassware, among which might be mentioned the alabaster arc light globes, used extensively on low potential arc lamps, the regular styles of arc lamp globe, but the more effective exhibits were the handsome designed shades for incandescent lights. The etched goods contain many beautiful patterns. In this line were shown plain pearl, and silver etched glassware. The ruby and rose, in many shades, which have become quite popular, were shown in many styles and patterns. The exhibit was in charge of Mr. J. K. Martin, who is well known to the trade.

The Westinghouse Electric & Mfg. Co. occupied the parlor at the right of the main entrance to the hotel with an exhibit of special goods. Some special literature had also been prepared which was distributed. The exhibit of stopper lamps was especially attractive as it had been prepared with great taste and showed many new and handsomely decorated lamps. The Wurtz lightning arrester was shown connected to line and its operation was demonstrated.

The Standard Underground Cable Company had headquarters in parlors 236 and 237 of the Hollenden where someone was always to be found well acquainted with underground and aerial cables and wires. There were present at the convention Mr. J. W. Marsh, vice-president and general manager from Pittsburg; Mr. G. L. Wiley, eastern manager from New York; Mr. J. R. Wiley, western manager from Chicago, and Mr. H. W. Fisher, electrician from Pittsburg.

The Bryant Electric Co., made an extensive exhibit of switches and specialties among which were a number of new ones which have recently been placed on the market. Mr. W. C. Bryant, the president of the company, and Mr. Thos. G. Grier, western representative of the company, were in attendance. A collection of stories, entitled "Tales You Have Told or Heard Before," compiled by Mr. Thos. G. Grier, was distributed and fully appreciated.

The Perkins Electric Switch Manufacturing Company, Hartford, Conn., was well represented at the convention and showed its enterprise in many ways. The company made a great hit in advertising by introducing a novelty consisting of a little red wheelbarrow that went along very much like its business because, as explained, "it was pushed." The company had samples of its switches and other specialties on exhibition. The interests of the company were well taken care of by Mr. J. J. Gates, of the home office, and Mr. Geo. W. Conover, of the western office.

The Electro Nickeling of Metallic Surfaces.

The following baths (most of them well known) have all given good results, but require careful handling:

1. 8 kilos. nickel ammonium sulphate in 100 liters of water, made slightly alkaline with ammonia, and then weakly acidified with citric acid.

2. 5 parts nickel sulphate neutralized with ammonia, 3.75 ammonium tartrate, and 0.025 gallotannic acid per 100 of water. This gives a homogeneous white and smooth reguline deposit, even when of great thickness.

3. 2.75 nickel acetate, 2.5 calcium acetate, and 100 of water, afterward mixed with 0.7 part of acetic acid (sp. gr. = 1.047) and filtered. (Potts' formula.)

4. 5 nickel ammonium sulphate, 2 ammonium sulphate, 0.5 citric acid, and 100 of water. Boil and filter.

5. 8 nickel ammonium sulphate, 1 ammonium chloride in 100 of water, with or without the addition of 0.5 part barium oxalate.

6. 6 nickel ammonium sulphate, 3.5 ammonium chloride, and 2.5 ammonium sulphate per 100 of water.

7. 5 nickel ammonium sulphate, 1 ammonium sulphate, and 100 of water. Specially suitable for cast iron.

8. 5 nickel ammonium sulphate, 2.5 boric acid, 100 water.

Powell has found that the addition of not more than 1 to 8 grms. per liter of benzoic acid or of a benzoate to a suitable nickel bath produces a good and pure deposit. Baths containing boric acid, such as are commonly employed, give a good deposit upon smooth surfaces, but refuse to cover cavities or hollows; this difficulty may be removed by the addition of sodium chloride to the bath. Such a bath may be made by dissolving 5 kilos, nickel ammonium sulphate in 100 liters of water, adding 2.5 (or 1.25) kilos. of boric acid and 1.25 kilos. of sodium chloride, boiling, acidifying with critic acid, neutralizing with ammonia, and filtering.

So also nickel chloride with boric acid in the proportion of 5:2 or 2:1 gives a good bath, but it is not suitable for depositing upon iron or steel, as all baths containing chlorine are apt to cause rusting of these metals. The use of citric, benzoic, tartaric or other weak acids is to be recommended for them, except upon the score of expense. —Ding. Poly. J.

ELECTRIC LIGHT AND POWER

EXTENSIONS AND IMPROVEMENTS.

Key West, Fla.—The Key West Gas & Electric Company is considering the operation of a railway at that place.

Toledo, O.—Home Heating & Lighting Company expects during the present year to double its capacity, installing additional machinery of all kinds.

Chicago Heights, Ill.—The plant at Chicago Heights is not yet completed but the work is being pushed forward rapidly. Mr. W. G. Caldwell is in Chicago.

Fredericktown, Mo.—The Fredericktown Electric & Mfg. Co. is erecting a six ton ice-making plant and cold storage rooms which will be completed on May 1.

Pittsburg, Kas.—The Pittsburg, Frontenac & Suburban Electric Railway Co., is preparing to build four miles of additional road and complete the necessary electric equipment.

Ontario, Cal.—The Ontario Electric Company contemplates the building an operation of a complete electric light, heat and power plant. The company owns a water power of 1,000 horsepower which will be used to operate the plant.

Salisbury, Mo.—The city plant will be enlarged by the addition of a one thousand light alternator, a 20x48 Corliss engine, for which the present engine is to be exchanged. The superintendent of the plant is Mr. W. A. Howard.

Jefferson City, Mo.—The Jefferson City Light, Heat & Power Co., has decided to add to its present equipment one 1,000 light dynamo to furnish light and power. When the addition is made the plant will be operated during the day.

It is conceded by all wheelmen that some lubricant is needed to prevent wear of chain and sprocket wheel; such a lubricant not only prevents wear but very largely increases speed and ease of driving. Oil or grease, while useful for the moment, catches and holds dust and dirt. After much experimenting it has been found that graphite makes the most perfect lubricant, when the right kind is used and properly prepared.

The word graphite, like the word charity, covers a multitude of sins. Under the name of graphite lubricant are found compounds of cheap black-lead, stove polish, foundry facings, soapstone, etc. Safety in buying, and the surety of getting the best graphite lubricant made, lie in purchasing of a firm of world wide reputation and long experience. Such a firm is the Joseph Dixon Crucible Company, of Jersey City, N. J. They have mined and manipulated graphite for nearly seventy years, and when called upon by leading wheelmen to furnish a cycle lubricant that would meet the fullest requirements of the cycler, they first purchased samples of all the chain lubricants in the market and analyzed them, and then selected from their choicest stocks of graphite a brand of graphite of unequalled smoothness, and produced a stick, or solid lubricant, which will not gum or hold dirt and dust, but which will so thoroughly lubricate the chain and sprockets that the wear will be reduced to the slightest degree, and ease of riding and speed greatly increased.

The Review of Reviews for March contains, among its usually bright and interesting articles, a description of the electric railway system at Buda-Pesth, which is constructed on the conduit system with underground trolley.

FINANCIAL.

But little can be said of the financial situation for the past month. The business in some quarters is reported as good as for the same month in 1892. The principal fault found in all lines of business is the low prices. There are no indications of an advance and many who had hoped that the early spring would see a change are greatly disappointed. With the amount of business little fault is found, but with the low prices received show little, if any profit. The same amount of business with the prices of '92 would have shown a large profit. The encouragement, however, of a more general trade is sufficient to place business on a better footing. The bulk of the business is done on a cash basis and with present prices it is hard to see how it could be done on any other.

The stock markets are extremely quiet and electric stocks have declined slightly. This is particularly true of manufacturing stocks. Illuminating companies hold their own. General Electric is again below 30 and shows no activity. This decline can be attributed to no event of recent occurrence but is perhaps influenced by the expectation of an unfavorable decision in the Bate's refrigerator case.

The balance of the first block of new stock offered by the Bell Telephone company has been taken, the price being 189¼. The results were considered satisfactory to the officers of the company. Western Union remains above 87. These stocks may also be influenced by the expected decision in the Bates Refrigerator case. that will affect patents which they have long controlled.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Feb. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	191½
“ “ “	Bds. 1893.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co.... ...	Com.	14,000,000	100	....	....	92
Commercial Cable Co	Com.	7,716,000	100	....	....	138
Chicago Edison Co , Chicago....	Com.	3,000,000	....	8	F. Q.	128
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	Q. F.	122
“ “ “ ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
“ “ “	C.Bds. 1901.	586,500	100	6	M. & N.	......
“ “ Brooklyn..	Com.	2,500,000	100	....	Q. F.	108
“ “ “ ..	1st. 1940.	500,000	100	5	A. & O.	100
“ “ “ ..	Regis.	....	100	5	A. & O.	.....
“ “ New York.	Com.	7,938,000	100	....	Q. F.	96½
“ “ “	1st 1910.	2,562,000	100	5	M. & S.	108
“ “ Phila......	Com.	1,473,000	100	....	....	120
“ “ “		....	....	5	....	.....
Fort Wayne Elec. Co...... ...	Com.	4,000,000	25	....	....	......
General Electric Company.	Com.	30,457,000	100	....	....	28⅜
“ “	Prf'd.	4,251,900	100	....	....	67
“ “	Deb. 1922.	10,000,000	100	5	J.-D.	89½
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	104
Standard Underground Cable Co.	Com.	1,000,000	100	....	....	92¼
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	...	....	......
Thom-son-Houston Elec. Co .. .	Series D.	120,000	10	....	....	5⅜
Thom'n-Houst'n Intern. Elec. Co.	Com.	600,000	100	...	....	.....
“ “ “ “	Prf'd.	400,000	100	....	....	......
United Electric Securities Co....	Com.	1,000,000	100	....	....	......
“ “ “	Prf'd.	1,000,000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q. J.	88
“ “	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5,333,940	50	....	....	32
“ “ “	1st Pf.Cum.	3,755,700	50	7	....	48
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R...............	Com.	6,000,000	10	....	Q.-J.	170
“ “	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
“ “ “ ..	1st Bds.1909	300,000	100	5	J. & J.	90
“ “ “ ..	Certf. 1894.	300,000	100	6	J. & J.	100
BUFFALO—						
Buffalo St. Railway..............	Com.	5,370,500	100	5	....	57½
“ “	Bds. 1931.	5,000,000	100	....	F. & A.	100
BOSTON—						
West End St. Railway...........	Com.	9,085,000	50	..	J. & J.	47
“ “	Prf'd.	6,400,000	50	5	J. & J.	77
“ “	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	37
“ “	Prf'd.	1,000,000	100	5	A. & O.	87
“ “	1st Bds.1930	6,000,000	100	....	J. & J.	......
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
“ “	Bds. 1930.	6,000,000	100	5	J. & J.	93½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	120
“ “	Bds.	2,000,000	100	....	....	105
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	...	....	27
“ “	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	19
“ “ “ “ “	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3,000,000	50	....		38
“ “ “	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000,000	25	....	......	13
“ “ “	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company.. .	Com.	5,000,000	100	....	....	38
“ “ “	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway..............	Com.	2,500,000	100	....	Q.-J.	105
“ “	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban............	Com.	2,500,000	400	....	....	20½
“ “	Bds. 1921.	1,400,000	100	6	F. & A.	90
Union Depo Railway............	Com.	1,200,000	100	....	....	110
“ “ “	Bds. 1910.	1,000,000	100	6	A. & O.	104

TRADE PUBLICATIONS.

The Metropolitan Electric Company, Chicago, is just mailing to its friends and customers a very handsome calendar, the design of which has been worked up with great care, and is especially artistic. The name of the company stands out boldly so that it is easily seen and on the side is an ideal figure holding an arc lamp, which sheds its light over the scene. It illustrated well the enterprise of the firm and will be appreciated by everyone fortunate enough to receive a copy that may be had for the asking.

There has recently been received from Elliott Bros., of 101 and 102 St. Martins Lane, London, W. C., their new catalogue for the present year of electrical and scientific instruments. The instruments of this company are well known and are found in many of the private as well as university laboratories. The company does experimental work and maintains a standardizing department for testing and calibrating electrical instruments. The volume is bound in heavy board covers, and contains lists of prices of all kinds of electrical and scientific instruments. The catalogue is sent upon application.

For the information of intended exhibitors at the exposition at Atlanta during the fall of the present year the Cotton States and International Exposition has issued a pamphlet of the classification of exhibits. The classification of the different portions is accompanied by views of the building which it occupies. Department F, electricity and electrical appliances, includes groups 56 to 72. Besides the exhibits made by local companies in this department there are the exhibits from the United States Patent Office of the electrical models and drawings, and also foreign exhibits of a similar character. This pamphlets may be had upon application.

The illustrated catalogue and price list of pumps and hydraulic machinery of the Goulds Mfg. Co., of Seneca Falls, N. Y., has recently been issued in its thirty-fifth edition for 1896. The volume is greatly enlarged and improved and contains many new pieces of pumping machinery. It is substantially bound in cloth, and contains nearly 400 pages. The various machines, devices and appliances used in connection with the elevation and distribution of water and other liquids are clearly illustrated by numerous cuts. The line listed seems to include everything in use in this connection. An extensive line of power and force pumps are contained in that department.

Catalogue B of Hart switches has been received from the Hart & Hegeman Mfg. Co. of Hartford, Conn. The catalogue describes the many styles and types of switches manufactured by this enterprising house. All the switches are mounted on porcelain, and the movement is rotary in one direction by quarter terms. The make and brake are instantaneous. The switch plates remain stationary until the handle has been given a quarter turn and the actuating spring has been given its maximum tension, the contact is then broken and made almost instantaneously. The best possible insulation is used and skillful workmanship is employed in their manufacture. The many styles of switches are illustrated by clear cuts showing every detail of their construction. Several new types of switches are noticed, and the usual excellence in every part of the catalogue.

The new catalogue of the Berryman feed water heater and purifier illustrates and describes the construction and operation of this well-known feed water heater, which for nearly a quarter of a century has been before the public. During this long period it has been greatly changed, as experience has shown where improvements could be made. The heater of the present day does not contain much which was found in the original heater, although the fundamental ideas which were involved in its construction are still found to be correct. The aim of the perfect feed water heater is heat and cleanliness, two essential qualities which have always been in the mind of the designer of these heaters. To take from the exhaust steam its heat and to give it to the feed water before it enters the boiler was the first object; to remove all, sediment and mineral formation which would be deposited on the shell and tubes of the boilers was the second object. How well these two objects have been obtained is shown by the excellent record of these heaters. The various details of the construction of the heaters are shown by cuts and the accompanying descriptive matter brings out their respectful features. Heaters are constructed for all types of boilers, and for the use of condensing engines a supplementary system of feed water heaters and purifiers has been designed. It is described in this catalogue.

The Electrical Engineering Co., of Minneapolis, Minn., has just issued to the trade catalogue Number 3 of electrical supplies and apparatus. The catalogue is of large size and will compare favorably with any so far issued. The electrical supplies listed include those for electric lighting, street railways and line wiring. In addition to this the company does a large contracting business for complete plants for light, power or telephone service. In compiling this catalogue the company has sought to avoid making a bulky volume, but in seeking to present extensive lines of goods for the trade it has been found necessary to occupy some 300 pages. The well-known brands of "O K Weather Proof" and "Paranite" wires are listed in the many sizes and kinds used. The line of wires also include cables for all kinds of service, lamp cords, magnet wire, etc. The line of supplies for incandescent installments is most complete in every particular; incandescent lamps and fixture glassware are handled in all the modern styles. Central station supplies and apparatus are also extensively listed, together with tools for construction and maintenance. The Monogram telephones which the company has placed upon the market are described and illustrated in the catalogue. In connection with these instruments the company offers an automatic system for telephone connections, which requires neither office nor operators. The company offers the entire apparatus for telephone systems or contracts for the complete installation. House supplies, annunciator systems, etc., are given in the catalogue. Electrical street railway supplies are also handled by this house and a considerable portion of the catalogue is devoted to this department. The standard type of generators and motors are handled by the company. The catalogue is well gotten up and bound in flexible covers.

NEW BOOKS.

National Electric Light Association, Proceedings of the Seventeenth Annual Convention, 1894. New York: Published by order of the executive committee. 370 pages; cloth.

The proceedings of the seventeenth convention of the National Electrical Light Association which has just been distributed by the secretary shows the usual taste in its make up, and contains a full and complete account of the proceedings of that convention. The frontispiece is a portrait of Mr. E. A. Armstrong, the president of the association at that time. Accompanying the lecture by Messrs. T. C. Martin and Luther Stieringer on "Electrical Lighting at the World's Fair and Some of Its Lessons" are given half-tone engravings of the views which were shown by the stereopticon on that occasion. The binding is uniform with the preceding volumes.

Street Railway Investments: A Study in Values. By Edward Higgins. N. Y. 1895. The Street Railway Publishing Company. Cloth; 102 pages; price $2.00.

In this work there has been given by the author a review of the street railway situation from an investor's standpoint. He has sought to give an unbiased opinion drawn from the statistics which he has obtained and the investigation made of a large number of the street railways of the United States. In considering these railways he has divided them according to the size of the cities in which they are located. Thus he treats first surface railways in cities and towns of less than 15,000 inhabitants, then those in cities from 15,000 to 25,000 inhabitants, then those in cities from 25,000 to 30,000 inhabitants; following these he takes up the railways of cities of 35,000 to 50,000, then cities of 100,000 to 500,000. Chapter nine is devoted to surface in elevating railways in American cities of over 500,000, and chapter 10 to interurban electric railways in America. In the introduction to the work he reviews the conditions under which the railways have reached their present position, and on following pages under general conditions brings out some of the traits of Americans, such as carelessness of small economies and his craving for greater facilities of transportation. The volume brings to mind many facts which cannot be overlooked by investors in street railway securities, and presents statistics from which the reader may draw his own conclusions. In considering the railways of the larger cities the author has been more specific and has given facts regarding individual cases. In conclusion the author says: "The street railway field has been so thoroughly investigated, especially during the last five years, that it is now difficult to find many wholly new opportunities for the profitable investment of capital." "The gross street railway mileage of the country, therefore, is not likely henceforth to show more than a gradual increase unless the demand interurban systems shall reach large proportions."

New Publications.

A new publication devoted to British electrical patent matters and called Electrical Discovery, made its appearance with the present year. It is published at 31 High Holborn, London, W. C., England. It contains lists of inventions on which patents are applied for and illustrations and descriptions of electrical inventions for which patents are granted. Its field is confined entirely to British patents.

Binghamton Railroad Co., Binghamton, N. Y., has issued a very tastily gotten up pamphlet, which contains views of the parks and attractive points of the city along the line of the railroad. These views are accompanied by descriptions of the attractive features of the city and of the accommodations of this excellent railway system. The railway does a large excursion business during the summer months, carrying passengers to and from the many pleasure resorts about the city. The company has done much to encourage this travel, and this pamphlet will undoubtedly be very beneficial in distributing information concerning the city and its interesting attractions. The pamphlet also contains views of the power stations and sections of the lines of the railway. The views of Ross Park show attractive drives, attractive bits of scenery and pleasant walks, roads and playgrounds for recreation.

PERSONAL.

Mr. James R. Wiley has recently been appointed manager of the western sales department of the Standard Underground Cable Co., with headquarters in the Rookery Bldg., Chicago. Mr. Wiley is well-known in electrical circles, having been connected with electrical enterprises for many years. For eight years he was with the Metropolitan Telephone & Telegraph Co., as superintendent of private lines. He is a brother of Mr. Geo. L. Wiley, who has represented so successfully the Standard Underground Cable Co. in the east for the past ten years.

Mr. Geo. W. Patterson, who is known to the electrical fraternity through his connection with the well-known firm of S. F. B. Morse & Co., was married February 28 to Miss Harriet O. Russell at the home of her parents, 6404 Madison avenue, Chicago. The wedding was a quiet one, only a few intimate friends and relatives being present. The presents were numerous and handsome, and the firm took this occasion to show their appreciation of Mr. Patterson's services by a substantial promotion. The couple have received best wishes of many friends, with whom the ELECTRICAL INDUSTRIES joins in extending congratulations.

BUSINESS NOTES.

AMERICAN ELECTRIC CO., 102 Pearl St., Boston, has been purchased by Mr. H. A. Williams. The transfer involves machinery, tools, stock, patent rights, etc. The gas lighting apparatus and appliances of the company are well known to the trade.

The Cutler-Hammer Mfg. Co., Chicago, had the misfortune to have their factory entirely destroyed by fire on Feb. 27th, but with their usual enterprise succeeded the following day in leasing a fully equipped factory at 16 and 18 So. Canal St., where they are now able to fill orders as usual.

THE PHENIX GLASS CO. has recently removed its Chicago office to 107 Madison St., where larger quarters near the center of the business district will enable it to serve more satisfactorily its many customers and friends. Mr. E. H. Fox, a Chicago representative, reports many new designs in glass ware for electric fixtures.

THE COMPTON ELECTRIC SERVICE CO., New York City, has received a very complimentary letter from the architect of the U. S. capitol, Mr. Edward Clark, stating that the thermostats placed at the capitol have proven satisfactory in service, and further states that they have added much to the comfort and convenience of the rooms.

F. E. BELDEN MICA MINING CO., Boston, Mass., miners and dealers in mica and manufacturers of ground mica, quartz, flint, and silex have established a branch at 182 Franklin St., New York City, which is in charge of Union Adams, jr., as agent. All the well-known products of this company will be found at this New York headquarters.

The Sunbeam Lamp Mfg. Co., Chicago, has again resumed the manufacture of the old Sunbeam lamp, patent litigation being at an end. This lamp had an established reputation with the trade before the factory was closed by injunction some time ago.

The Pumpelly Sorley Storage Battery Company, Chicago, was the most fortunate of the companies which were located in the district burned last month. The stock, machinery and material on hand were damaged but slightly and have been removed to 128 and 130 South Clinton St., where the factory is now established and again in operation.

The Strowger Automatic Telephone Exchange, Chicago, announces that it has the details of its system perfected and will hereafter furnish switchboards free of cost excepting a small yearly royalty for same. The company's advertisement will appear next month. In the meantime the company will be pleased to send circulars and catalogues to anyone who asks for them by letter or postal card.

The Independent Elec. Co., Thirty-ninth St. and Stewart Ave., has closed a contract with Picands, Mather & Co., iron and coal shippers of Cleveland, O., for the complete plant for mining and hauling coal in their No. 2 and 3 mines at Hazleton, Pa. This plant is intended to take care of 2,400 tons mine run coal. The power plant will be of 600 horse-power capacity and two 80 horse-power mine locomotives will be used for hauling the coal.

The Metropolitan Electric Company, Chicago, has just added to its long list of valuable specialties that of the Maxstadt fusible cut-out and the New Haven car register. This latter specialty is one of the best car registers in the market and the New Haven Car Register Company is especially fortunate in getting a firm so enterprising to push its specialty in the west. The Metropolitan company is now sending out a very handsome circular descriptive of the register.

E. W Cooke, formerly with the Great Western Manufacturing Company, has opened an office at 1649 and 1651 Monadnock block, where he will handle a number of specialties. Mr. Cooke has secured the western agency for several well-known specialties, among which are the Clark wire made by the Eastern Electric Cable Company, Boston, the Mason Regulator Company's product, also the agency for the Pecora Paint Company.

The Westinghouse Machine Co., Pittsburgh, Pa., finds its engines in demand in the remotest corners of the earth. Among recent shipments made to distant foreign parts are the following engines: A 150 horse-power compound of the latest type to Alaska, three 150 horse-power compounds to Mexico, one 200 horse-power compound to Spain, 300 horse-power compound to France, 150 horse-power compound to Buenos Ayres, 100 horse-power compound to Havana and a number of smaller engines to Russia and other countries.

Partrick & Carter Co., 125 S. Second St., Philadelphia, has prepared a very handsome sample board of some of their house good specialties, designed especially for small dealers and those who have not as yet carry a stock of such supplies. Everything is connected and in complete working order for practical exhibition. The board is made of hard wood and the dealer's name and address is placed on it in gilt letters. Their advertisement in this issue shows an illustration of this new sample board, which will be boxed and shipped complete with battery on receipt of price.

The Sprague Electric Elevator Company, New York, has just closed a contract for the equipment of the Parrott Bldg., San Francisco, Cal., with 15 electric elevators, eight of which are to be in operation by September 1. This building is to be the largest department store of the kind in the United States. The generating plant is to consist of four triple expansion high speed engines connected direct to eight 100 K. W. compound multipolar generators. The contract was closed through the efforts of Mr. C. A. Benton, the general sales agent of the Sprague company.

Jewell Belting Company, Hartford, Conn., reports the following list of orders for wide belts for month ending Jan. 14, 1895: 118 feet, 78 inch, four ply; 105 feet, 62 inch, three ply; 105 feet, 62 inch, three ply; 88 feet, 62 inch, three ply; 88 feet, 62 inch, three ply: 88 feet, 62 inch, three ply; 110 feet, 34 inch, three ply; 117 feet, 42 inch, double; 67 feet, 30 inch, double; 115 feet, 24 inch, double; 58 feet, 24 inch, double; 92 feet, 40 inch, double; 99 feet, 26 inch, double; 90 feet, 36 inch, double; 113 feet, 40 inch, double: 136 feet, 36 inch, double; 130 feet, 24 inch, double, and 86 feet, 26 inch, double.

J. E. Rhoads & Sons, of Wilmington, Del., are making a specialty of short lap electric belting or Volta dynamo brand, in which the leather is prepared in a special manner, that increases its pliability and adhesive power. These belts are giving excellent satisfaction, both in point of wear and in power-producing qualities. The greatest care is taken in their manufacture to insure a straight running and perfectly even belt. They are also making a specialty of a new kind of solid round belting and pole cord, called tannate. This is said to be as strong as raw hide and more serviceable, as it combines pliability with strength. The manufacturers have had an unexpectedly large demand for these goods.

The Central Electric Company, 173 and 175 Adams St., Chicago, is preparing for the warm weather which will soon be here, by placing a large stock of the well-known Lundell fan motors on sale. These fan motors have been extensively used and the Central company is looked upon as the headquarters for goods of this kind. While it may seem like rushing the season to call attention to cooling apparatus, it is well to be prepared in season. The policy of the company of carrying large stocks of all kinds of electrical supplies gives greater satisfaction to its customers. At the present time supplies are bought only for immediate use and orders require, therefore, quick delivery. The large stock carried allows the quick filling of these orders.

The Electric Appliance Company, Chicago, have purchased of H. P. Lucas, receiver, the catalogue, good-will and a large part of the stock of the Knapp Electrical Works (insolvent), and are prepared to fill all orders for "Knapp" specialties promptly from Chicago stock. The Knapp Electrical Works catalogue is the largest, most complete and expensive electrical supply catalogue ever published. The Electric Appliance Company are making some revisions and additions to the original volume, making it even more complete, and are now prepared to furnish them on application together with a new special discount sheet, quoting exceptionally low prices. To those who are now in possession of a copy of the Knapp catalogue they are prepared to send a new discount sheet applying on same, making prices which will get the business.

The Ball Engine Co, Erie, Pa., report recent shipments to electric lighting plants as follows: Siemens-Halske Electric Co., Chicago, Ill., two 160 horse-power engines direct connected to Siemens & Halske generators. Macy & Wales, Converse, Ind., one 100 horse-power tandem compound. Le Gran Fundicion Nacional Mexicana, Monterey, Mexico, one 60 horse-power engine. Knight Bros., Fayette, Iowa, one 50 horse-power engine. Texas Pacific Mercantile & Mfg. Co., one 50 horse-power engine. Receivers of Union Pacific Railway Co., Pocatello, Ia., one 40 horse-power engine. Atlantic Refinery, Point Breeze, Philadelphia, one 135 horse-power engine. Ballston Electric Light Co., Ballston Spa, N. Y., one 100 horse-power tandem compound. D. M. Fulmer Lumber Co. (electric light plant), Florence, Wis., one 70 horse-power engine. Forest City Electric Light Co., Forest City, Ia., one 70 horse-power engine. Siemens-Halske Electric Co., Chicago, Ill., one 70 horse-power direct connected engine. Hahne & Co., Newark, N. J., one 125 horse-power engine. Tootle, Wheeler & Motter, St. Joseph, Mo., one 80 horse-power engine. J. W. Warner, Oneida, N. Y., one 60 horse-power engine. Crook, Horner & Co., Baltimore, Md., one 80 horse-power engine. Charles E. White, Philadelphia, Pa., one 60 horse-power engine.

Walker Manufacturing Co., Cleveland, O., reports among recent orders the following: The Complete Electric Construction Co., New York City, two 50 KW belted lighting generators. The Rahway Electric Railway Co., Rahway, N.J., one 100 KW belted multipolar generator, three double XX car equipments, 25 horse power spring mounted steel motors. The Philadelphia Construction Co., Philadelphia, Pa., for The Schuylkill Electric Railway Co., Pottsville, Pa., three 400 KW belted generators and switchboard apparatus, two double car equipments, 25 horse-power motors. The Michigan Electric Co., Detroit, Mich., for Saginaw Consolidated Street Railway Co., Saginaw, Mich., one 200 KW belted generator, six complete car equipments, 25 horse-power motors. Hartford & West Hartford Street Railway Co., Hartford, Conn., two double car equipments, 50 horse-power steel motors, two double car equipments, 25 horse-power steel motors. C. E. Loss & Co., Chicago, Ill., for Waukesha Street Railway Co., Waukesha, Wis., one 150 KW belted generator, three double car equipments, 50 horse-power steel motors. The Detroit Railway, Detroit, Mich., two 400 KW direct coupled generators, one 750 KW direct coupled generator. Gloucester, Essex & Beverley Street Railway Co., Gloucester, Mass., two 225 KW direct coupled generators. The Worcester Construction Co., Worcester, Mass., for The Gloucester, Essex & Beverley Street Railway Co., sixteen double car equipments, 25 horse-power steel motors. Jaspar County Electric Railroad Co., Carthage, Mo, two 200 KW belted generators, five double car equipments, 30 horse-power steel motors. Besides the above they have taken orders for their spring mounted steel motors for the Louisville Railway Co., Louisville, Ky., Atlantic Avenue Railway Co, Brooklyn; Ottumwa Electric Railway Co., Ottumwa, Ia.; Aurora Street Railway Co., Aurora, Ill.; Bloomington City Railway Co., Bloomington, Ill.; Steinway Railway Co., Brooklyn; Kansas City Railway Co., Kansas City; Atlanta Electric Railway Co., Atlanta, and many others. They have also taken large orders for their general work, among which might be mentioned contract for four 2,000 ton hydraulic cotton compresses for Mr. W. W. Bierce, Montgomery, Ala.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. April, 1895. NEW YORK. No. 4.

An Electric Power Distribution and Lighting Plant.

The electrical systems of power distribution have been of more recent development than the lighting systems that are now almost universally used. This was not on account of a better knowledge of one or the other but because one seemed to promise greater returns, electrical power distribution having to compete with long established methods. These methods were well understood and their construction or repair involved but ordinary ability, while the electric system was new, untried and its economy could not be guaranteed. The greater proficiency that was soon attained in the manufacture of electrical machinery gave more efficient machines at a much lower cost and more attention was given to this branch of the industry.

The first installations attracted attention of power users and demonstrated the many advantages of the system. The public has since become more familiar with electrical machinery and such plants are now quite common in factories and manufacturing enterprises where power is required at a large number of points distributed over a considerable area. While the enthusiastic expert has been figuring on how far electric power can be commercially transmitted, the more practical man has been seeking to utilize electric power in the present plants. The larger the works and the more diversified the character of the machines the better electricity seems to be adapted for the service. The direct current is used where the works occupy one piece of ground and is the most satisfactory up to certain distances. The cost of transformers and the loss in transforming the current, together with the less efficiency of the alternating current motors, gives the direct current the advantage up to such distances as the loss of current in transmission more than outweighs the less efficiency of the alternating system.

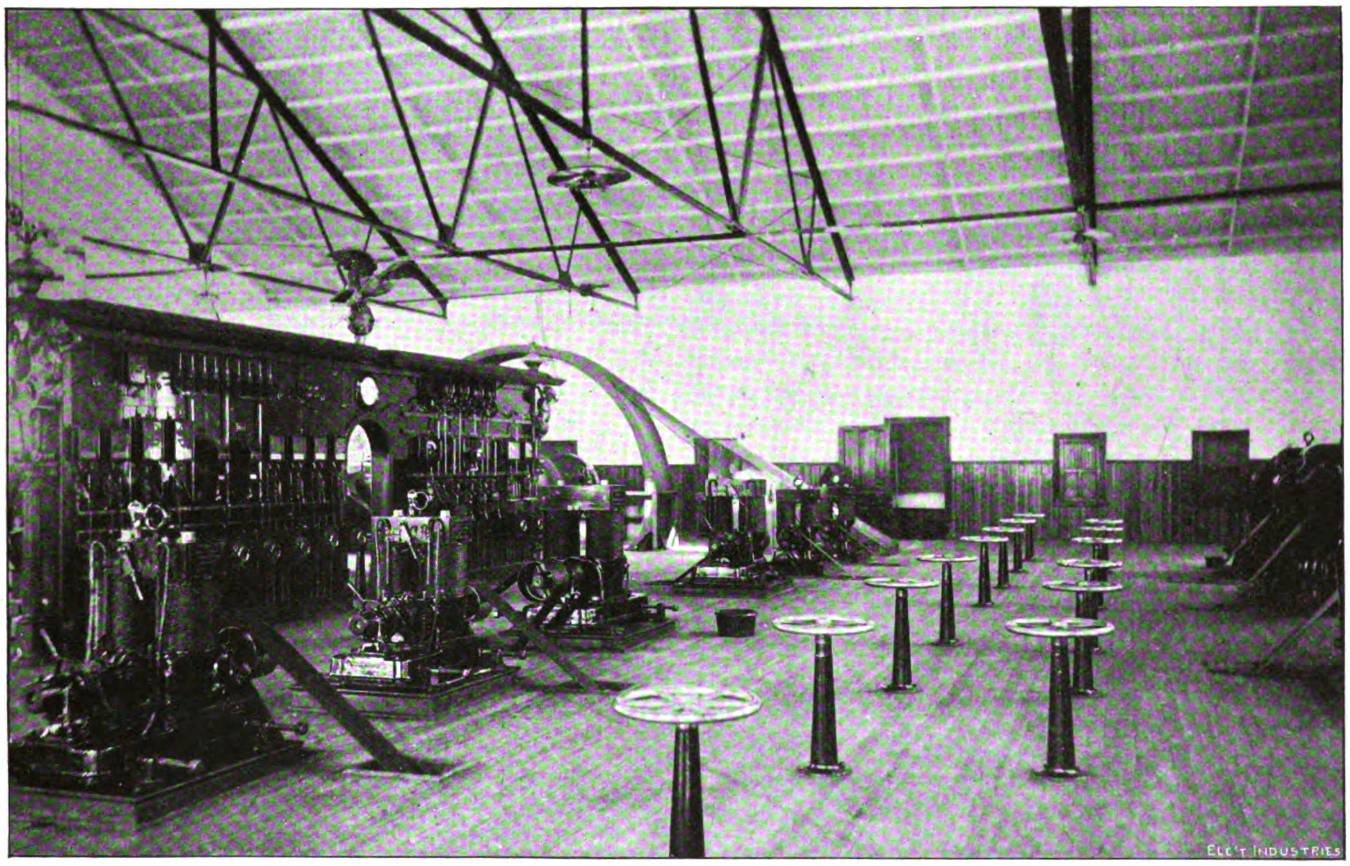


FIG. 1.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT.

A little over a year ago there was erected at the Illinois State Penitentiary a central power station which took the place of the many separate power, heating and lighting plants that were then in use. Although this plant is not yet fully completed, which is due to several causes, the system has so many advantages over the previous system that the correctness of the change is not questioned. The accompanying engravings show the interior of the power station.

The power station is located at about the center of the prison grounds. It is large in size with ample room for a much larger power equipment. The walls are of stone and the roof is supported on steel trusses. The station is really two buildings as shown in the illustration, Fig. 3, but has a common partition wall. The engine and dynamo room is lighted by windows on three sides, which give it a bright pleasant appearance. The grounds have been slightly terraced about the buildings and the flowers that grace the windows removes the cold, barren appearance that is usually noticeable in buildings of this kind.

The basement extends under the entire engine room and contains the shafts, clutches and various connecting devices. It is high and well lighted. The second part of the station contains not only the boiler room, pumps, etc., but also the engineer's office, store room, room for the apparatus of the fire department, etc. From the building a branch runs to the main line of subway which reaches all the main buildings. This subway is of sufficient size to hold the large steam pipes of the heating system, the gas pipes, electric wires when they are placed underground, etc. Manholes are placed at frequent intervals for workmen to enter for the inspection or repair of the lines. This subway system has been found a most valuable method of placing the different distributing systems underground, as it saves all excavating when for any reason it is desired to get at the mains.

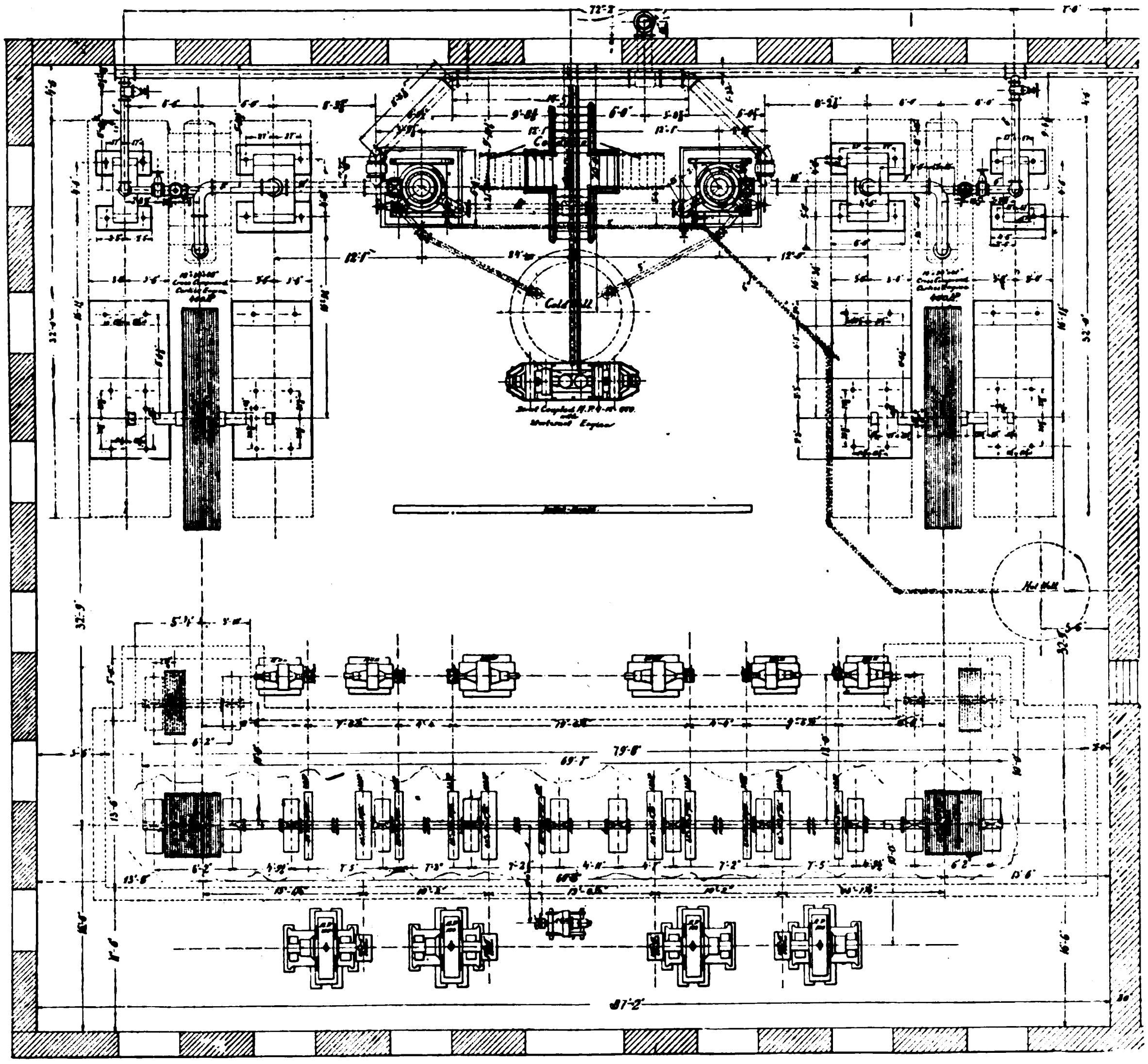


FIG. 2.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT.

The boiler room furnishes steam not only for the engines of the power station but furnishes steam for heating the prison buildings, steam for cooking purposes, the laundry, etc. The greater part of the steam generated during the winter months is used in the extensive heating system. Every large building on the 15 acres of ground occupied is heated in cold weather. The water from the condensation of the steam from the pumps, heating system, etc., is returned to a large tank at the base of the chimney at a temperature of from 170 to 190 degrees from which it is again pumped to the boilers. The boiler plant consists of four Campbell & Zell water tube boilers of 300 horse-power each. Steam is carried at 125 pounds pressure. Block coal is used and sawdust and refuse from the furniture shops is burned, being carried through chutes to the boiler furnaces.

The pumps are located in a separate room adjoining the boiler room and contains one 18½ by 14 by 10 Worthington fire pump, two Worthington boiler feed pumps, one Marsh pump and one Deane pump. The pumps are all interchangeable, so that any or all can be used for boiler feed water supply or fire purposes. Should the larger pump get out of order at the time of a fire the other pumps can be put in use immediately. The hose house, which is also in this building, contains two hose carts with one thousand feet of two and one-half inch fire hose and a chemical cart. A fire department composed of convicts is kept drilled and ready for fire duty at all times. The pumps are in charge of a convict and the furnaces are fired by convicts. In fact all labor about the steam plant is performed by the prisoners. Immediately in front of the boiler room and next to the chief engineer's office is the store room where is kept a line of supplies such as are constantly being used or liable to be used should any part of the plant break down. A defective part is soon repaired and shut-downs are quite unknown.

The engine equipment consists of a four hundred horse-power Allis-Corliss cross compound condensing engine and a one hundred horse-power Westinghouse standard engine as shown in Fig. 4. The engines are mounted on stone piers solidly constructed. The piers are not in any way connected to the building foundations so that one is not affected by the other. The engines operate very smoothly and are entirely free from vibrations. The engine room was planned for two large engines and foundations were built when the power house was erected for another engine of 400 horse-power. The foundations are in and the shaft is equipped with grooved pulley for rope transmission similar to that now used on the present large engine.

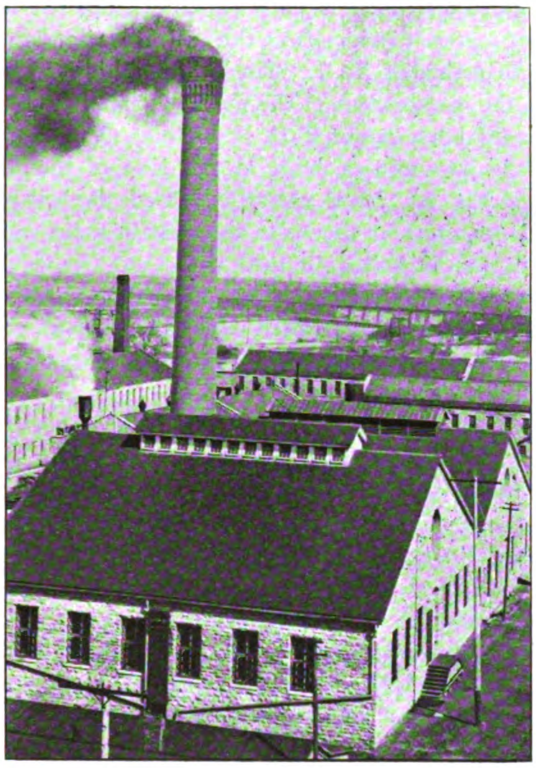


FIG. 3.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT.

This system of rope drive is that of Mr. J. H. Hoadley and is known as his patent compound wind. The compound multiple winder is placed between the flywheel and the shaft pulley. The tightening pulleys are also placed in the basement. The rope used is one and a quarter inches in diameter, and is capable of transmitting several times as great a load as is ever placed upon it. The arrangement of the power plant is such that the floor of the engine and dynamo room is almost free of belts. The 100 horse-power engine is belted to a shaft which can be connected to the larger shaft. Any machine can thus be operated by the smaller engine. The power plant and machinery is under the supervision of the chief engineer, Mr. H. B. Quick.

The electrical equipment was furnished by the General Electric Co. The power station contains three multipolar compound wound generators of 100 kilowatts each; two 25 kilowatt Edison dynamos; four 15 kilowatt Edison and one 20 light arc machine of the T-H type. All machines are connected to the switchboard, which is placed in the center of the engine room. Each machine is belted to a friction clutch pulley on the shaft in the basement. This clutch is controlled by a hand wheel placed in front of the machine. The dynamos have each a switch mounted on frame by which the circuit may be opened. The current from the machine can be instantly cut off and the dynamo quickly stopped. These dynamos are of the standard bi-polar Edison type, are mounted on bases with sliding rails for increasing or decreasing the tension of the belt.

The machines are placed in two rows with the exception of the arc machine, and the shaft to which they are conconnected, is directly beneath the center between these two rows. The Edison dynamos are 110 volt machines and the multipolar generators are 220 volt. There are about 2,000 incandescent lights fed from this plant, distributed as follows: 1,000 cell lights, lights in offices, warden's residence, corridors, shops and power station. In such shops only have lights been installed as the work demands at certain times of the year extra light at the close of the day. In the knitting shop, in the reed and rattan shop and a few others incandescent lights are used. These lights are wired on the three wire system and are to a large measure controlled from the main switch board. The heaviest load is carried till nine o'clock in the evening. Till this time the one thousand cell lights are burned. At five minutes before nine the corridor lights are turned on at the switchboard and at nine the cell lights are turned off.

The load at this time is shifted from the large engine to the 100 horse-power engine, which carries the night load. This load consists of the arc lights, which are placed so as to light the area within the outer wall and the open spaces between the buildings, lights in halls of warden's residence, guard's hall, hospital, etc. The arc lights also permit switching of cars and such other work as cannot be conveniently done during the day.

The switch board is built up of panels of black slate en-

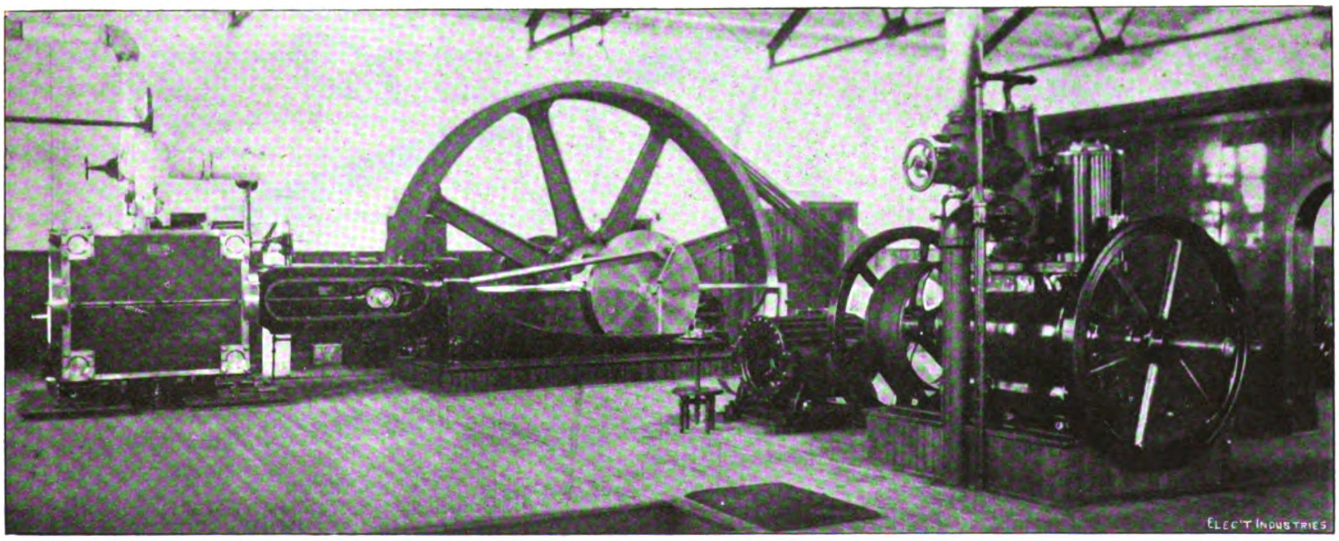


FIG. 4.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT.

closed in an ornamental wood frame. It occupies a prominent position in the dynamo room and is neatly finished and designed. The power generators are connected to panels at one end and the lighting dynamos are connected to the other. The two systems are separate but can be connected so as to substitute the machines of one kind for the other if occasion demands. The instruments and controlling devices are all mounted on the face of the board, from which every machine can be seen, with the exception of the arc dynamo. There is one panel left vacant on the board for the instruments for a fourth 100 kilowatt generator, which it is expected will be required in a short time.

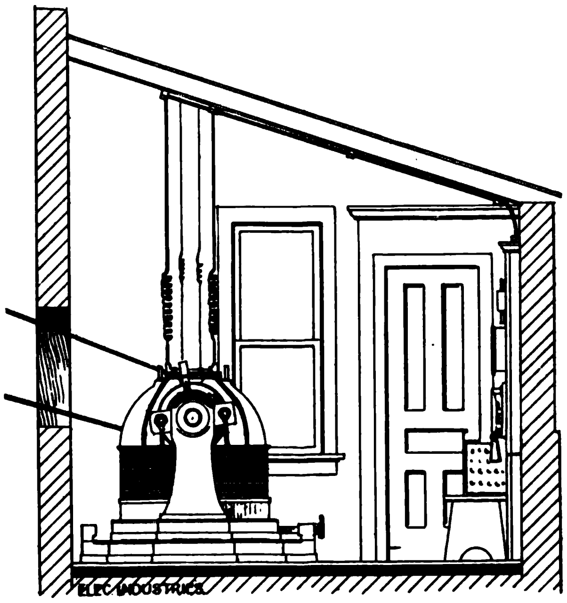


FIG. 5.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT —MOTOR HOUSE.

The most interesting part of the equipment is the use of electric motors in the shops. Until the present plant was built, each shop had its separate power plant. This system has been done away with except in one instance. Formerly the convicts were employed under the contract system, but as these contracts have expired the work has been taken up by the state. At the present time there are two contracts that have a few months to run. One of these is the shoe contract, and the machinery in that factory is operated by the same engine and boiler that has been for years in use. As soon as this contract is finished electric motors will be substituted and there will then be but one power station within the prison walls.

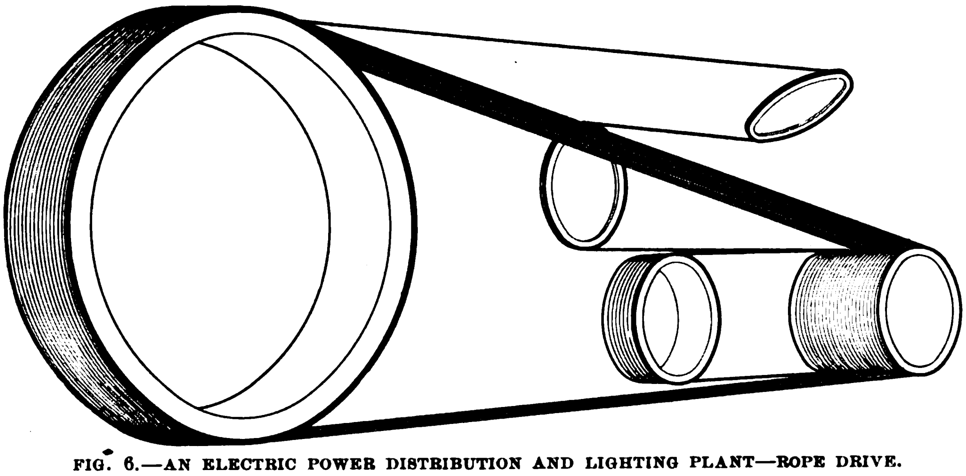


FIG. 6.—AN ELECTRIC POWER DISTRIBUTION AND LIGHTING PLANT—ROPE DRIVE.

The electric wires are run on poles to the different buildings; the appropriation made for the installation did not permit them to be laid underground. It is the intention to gradually change this part of the system and place it underground in a permanent manner. In nearly every instance a separate room is provided for the motors. This plan gives them a clean, cool place, quite different from the interior of the shops. The dust in many of them would soon ruin the motor. The motors are placed in charge of a convict, who keeps them clean, bearings well oiled, and who starts and stops them as work begins or stops for the day.

At not a great distance from the central station is what is known as chair shop No. 1. The lathes and other machines used in the manufacture of the parts of chairs are operated by four 50 horse-power T-H. D. motors. The motors are located in two houses, built at the side of the shop, as shown in Fig. 5. Each motor is belted, the belt passing through openings in the walls, to a shaft in the center of the shop, that is belted in turn to counter shafts on each side, from which the long rows of machines are belted. The motor houses are provided with switch board, containing fuse blocks, switches, etc. A starting rheostat is also conveniently located.

The stone saw mill is operated by one 50 horse-power motor of the same type as the above. This motor is used intermittently, but has the great advantage over any other kind of power in that it is always ready when wanted. At chair shop No. 2 the machines are operated by a 50 horse-power slow speed multipolar motor, whose speed is better adapted to the machines there in use.

In the harness shop a ten horse-power T-H. D. motor furnishes power, and in the knitting shop one of similar size is used to operate the knitting machines. A ten horse-power motor also operates the sewing machines in the clothing department and the washing machines in the laundry. In the room where cane chairs seats are made a five horse-power T-H. D. motor operates the machines. In the broom shop a three horse-power motor, Edison type, runs the threshing machine that takes the seed out of the broom corn. In the female prison a one and a half horse-power motor runs the knitting and sewing machines. In addition to these a six horse-power motor is used in the saddle shop; a ten horse-power for operating the elevator, and a six and nine horse-power motor for running the hot air and ventilating systems in the cell houses complete the list of motors in use. The convicts have the care of these motors, and any repairing or wiring that is required is done by them. The electrical apparatus is under the supervision of Mr. J. M. Perry. The entire plant has been wisely planned, and when the plans are fully carried out it will be worthy of the careful inspection of those contemplating a change in present methods of power generation and distribution.

Some Faults in the Operation of Electric Plants.

BY C. E. WOODS.

The writer was much interested in some points in article No. 4, by Charles G. Armstrong, under title "Some Hints on Building of Electrical Plants," and cannot resist the temptation to give for publication some experiences of his own. The principle remarks in the aforementioned article that attracted the writer's attention, was to the effect that no matter how skillfully an apparatus had been designed, manufactured and installed it would be a failure unless properly handled. This is undeniably the experience of every parent company who manufactures electrical apparatus, and every electrical contractor who installs apparatus. The understanding of what consists in properly handling apparatus is in just about the same chaotic condition in many instances in the owner's mind as the original purchase and equipment of the plant was, only after having hired a competent electrical engineer, either by contract with the parent company, or independently, to supervise the parent company's work, they think from that time on the plant is, or should be automatic in its operation, and consequently in keeping with this idea, often put an automaton man in charge of it, and so really a cheap man in charge, so far as the electrical industry itself is concerned, is not in the the writer's estimation nearly so much to blame as those who employ him, and in results which they invariably obtain by such procedure they merit the punishment which they receive in the shape of trouble, losses and dissatisfaction.

Again the writer has seen most excellent men positioned in an environment which made it absolutely impossible for them to work on the strength of their own judgment and experience, caused solely by the placing of an ignorant man in charge of the plant, so far as electrics, dynamics or any other ics were concerned, which would bear directly on the actual running and delivering of results to the customer, as superintendent or general manager, and to illustrate this more forcibly the writer will relate two or three actual experiences which he has had of this nature.

While with a certain parent company, whose name is not necessary for the purpose, some apparatus was sold to a local company for the erection of a new plant in a fair-sized town; the contract for the apparatus simply called for the delivering of the apparatus at the said town, to be set on foundations and connected to switchboard, to which circuits were brought by other contractors. With the steam equipment of the plant, the electrical people had nothing to do, nor were they consulted in the arrangement.

After a necessary period of time had gone by which entitled the parent company to a settlement as per contract, demand was made for same, which was promptly refused by the local company, with the explanation that the machines were wholly unsatisfactory, giving varying light, by lights frequently jumping up and down, and being much better in some parts of the town than in others, etc., etc.

My position as chief inspector of the company caused me to be sent there to ascertain what the difficulty was, if possible. The arrangement of the plant, I found upon getting there, was two 250-horse-power engines, arranged one on either end of a long jack-shaft, so that both engines could work on the same shaft, or either engine run the entire shaft independently; these engines were backed up by ample boiler capacity, under which was burned for fuel, natural gas. The first evening I did nothing but take observations in a casual way, simply asking the engineer to proceed with the operation of his plant the same as he always had without reference to my presence or inquiries; this engineer being a very intelligent man and anxious himself to do anything that he could to remedy the unfavorable conditions of the plant, kindly followed my suggestions, and before ten o'clock in the evening had arrived, I had made a satisfactory diagnosis of the plant's operations in my own mind, and it simply remained then for me to prove it by the application of instruments; accordingly the next day I arranged two of my indicators on the engines and other necessary instruments in the plant; the result of the test was that I discovered they would run the first engine until the engineer thought he had a sufficient load on, then he would throw the other engine onto the shaft; also when he thought the load was off enough, later in the evening, he would cut down one engine, throwing the entire load onto the remaining one. Now this thought load, for which the engineer was in no way to blame, amounted to 350 horse-power in one instance, and 362 horse-power in the other instance, on a 250-horse-power engine. The equipment of the plant was several arc machines and alternators. After the engine received its normal load, as each arc machine was put on additional, the speed of the engine was slackened very materially, and it would, of course, very much affect the incandescent lights; the throwing on of the second engine restored the speed of the jack-shaft to normal conditions, causing thereby a boom in the incandescent lights, so to speak, until they could be adjusted.

The steam pressure was controlled by automatic gas regulators and did not vary a pound during the night's run; the engines under the load that they should have carried regulated within contract specifications. The engineer who had charge of the engines was a thoroughly competent man and understood perfectly well the use of the steam engine indicator, but being a man of a large family, he told me he could not afford to purchase one himself to use in his plant, and that his company would not entertain a proposition to get one for him at all. The result of it was he had done the best he could, but his thought load had been much larger than he had been lead to believe it was by the number of machines he had on.

The circuits of the incandescent system had been wired up by some local expert talent, which resulted in some of them having a drop of twelve per cent, while others were working on a drop of about four per cent, and in some of the secondary distributions from the transformers the same difference in losses was found to exist.

After I had finished testing this plant and had given the figures and facts into the office, there was no further difficulty in getting a settlement for the apparatus as per the parent company's contract. I neglected to state that in the electrician's outfit the only instrument he had of any value, was the customary and never failing magneto, a portable volt meter having been a much too expensive luxury for the company's electrician, who himself was a fairly good man. I succeeded in making this company order a portable volt meter, an engine indicator, as well as some minor necessities, before leaving them, and from that day to this there has been no trouble with that plant.

In another instance when settlement was demanded, prompt refusal was made based upon the assertion that they had bought the dynamos under a guarantee of ten lamps per horse-power, and as a matter of fact were only getting two or three, and that in lieu of paying for dynamos they were considering the advisability of substituting others in their place. Of course this called for an investigation, etc., and the writer was deputized to take up the matter.

Arriving at the town I found the plant equipped with one 500-horse-power cross compound condensing Corliss engine running a jack-shaft which carried several arc machines and alternators; this engine had been bought upon a guarantee of 2¼ pounds of coal per horse-power per hour; its maximum load was not found over 425 horse-power; its load from eleven o'clock until daylight was less than 100 horse-power, and the output of the dynamos was measured by the number of pounds of coal consumed, and the number of lights being carried as per the ampere meter allowing 2¼ pounds of coal per horse-power, basing the number of lights accordingly.

When the writer took possession of the plant to make the test the plant had been in operation some two months. The first thing he discovered was that the engineer from the manufacturers who had erected the engine for the local people had not indicated the engine before leaving it, having finished his work sufficient to get it turning over, he was sent to a very distant point before being able to do so; consequently the writer set out to see what he could find, and put four indicators on the engine, one on each end of either cylinder—results, at maximum load of 427 horse-power, 16 pounds drop between boiler and initial pressure of cylinder—72 per cent of the work on one end of high pressure cylinder—65 per cent of work on one end of low pressure cylinder, 9 pounds vacuum. On light load from eleven o'clock until daylight the high pressure cylinder was cutting a figure eight on the end of indicator card at about two-thirds stroke, being void of anything in the form of a terminal pressure, thus knocking the whole arrangement of the compound and condensing portion of the engine into a bewildering state, as they had always carried a 100-pound boiler pressure through the entire run. The first night run showed an average consumption of coal of 8¼ pounds per horse-power per hour.

The next day was spent in adjusting the valves; taking a couple of nasty crooks out of the main steam pipe, etc., etc. The next night's run showed a great improvement; from eleven o'clock until daylight the boiler pressure was carried down to such a point as would keep the terminal pressure on the high pressure cylinder up to at least four pounds, and thereby give the low pressure cylinder a chance for its life; coal consumption was reduced on the third night's run, after all adjustments were made, on an average of $3\frac{6}{10}$ pounds of coal to horse-power per hour, which was as good as could be expected, considering that three-fifths of the run was made at a load of about one-fifth the engine's capacity.

This is simply another instance of a plant equipped with good apparatus, good engines, good everything, but the necessary talent and instruments to keep tab on its operations from day to day, and so could the writer go on indefinitely almost, giving experiences of this nature which are nobody's fault in particular, but everybody's fault in general. Over one-half of such instances as this that the writer has ferreted out the troubles in, and placed to their proper account, have wound up in the steam end of the plant, not because of the steam apparatus being faulty always, but because the right combinations between steam and electrical units had not been taken into consideration as regards local conditions under which the plant had to operate, and often as in the two instances mentioned in this article, not because of ignorance on the part of the engineer; his only trouble was poverty.

Some Hints on the Building of Electric Plants.—V.

BY CHAS. G. ARMSTRONG.

It is one thing to know something and another to impart that knowledge to others, and the plant which has been described in the last four articles, now has entered upon an actual existence, and at this point, and not until now do I consider it ready to be shown to the general public, my principal reasons being, first, that one can scarcely tell what the result of all his planning may be, whether success or failure; and second that the publication of work of this kind is too apt to savor entirely of self-praise and to border too closely upon the advertising features, rather than upon the broad principle of giving something to the public which will be at once interesting and instructive. I cannot too strongly condemn the practice of some electrical engineers who rush into print with the astounding news that they have been retained to build a plant in Podunk, or some other place and then fill the already over-burdened pages of our electrical journals with tedious discussions as to what they intend doing, and which are mere repetitions of other work which has been done year after year by others. This tendency to boast of the work which we intend to accomplish, is apt to be too much like the little girl who asked her uncle to stand real still while she made his picture on her slate, and after completing the picture, looked at it a moment and said, "Well, uncle, I don't like the picture at all. I guess I will put a tail on it and call it a monkey," and if the facts were known there are a great many electric plants in operation today that are not worthy the name, and a slight modification would easily entitle them to be classed as another species, if not in another genus.

Our electrical friends when describing the different plants, should have in mind the wholesome advice of a noted orator who was asked by a student how to make a speech, and answered that the first and most essential thing, was to have something to speak about. What is there about the particular plant to be described worthy of a long and often tiresome explanation beyond the bare fact that a plant of a certain size has been successfully installed by some one?

What is the use of column after column, and cut after cut showing no new points or no radical improvements, but a reiteration of other articles published in some other similar journal week after week, and month after month? If there is any radical improvements or anything of general interests to the public, anything which would aid some other builder or designer wherein he could make better the plant he contemplates building, then there is good and valid reason for a description. The time was when there was so little to be written about in electrical work, that it was necessary to go into these details in order to make a sizable paper, but today when it represents one of the most active business interests of the country, it certainly behooves designers, writers and editors to insist more on the purely scientific, and less on the advertising plan in bringing before the public the various plants, in order that the greatest good may be obtained for the greatest number of people.

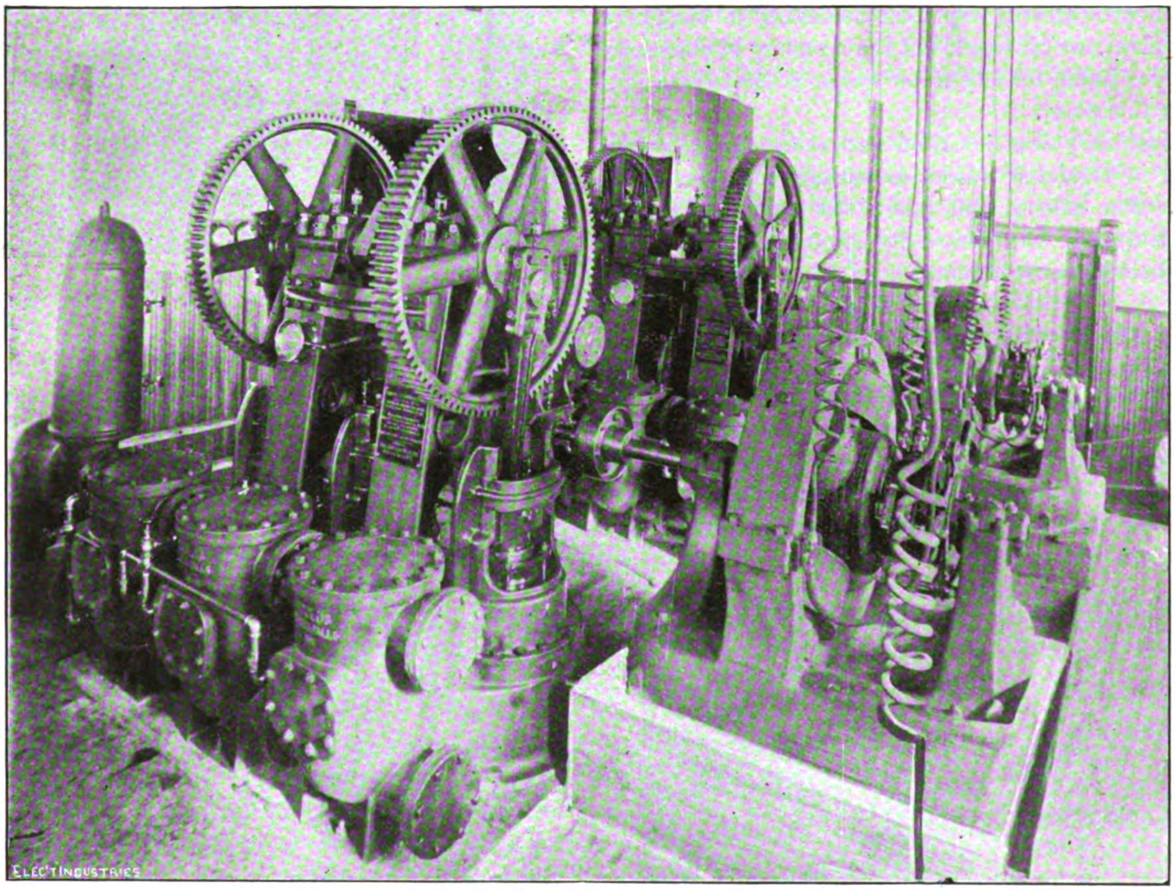
It has been my intention throughout this series of articles, to state clearly, fairly and conscientiously as possible, the various requisites in the planning, building, equipping and placing before the reading public of an electric plant, and while many of my readers may have no need for the hints contained herein, and if some of the thoughts may have fallen on the barren ground, yet if some have fallen by the wayside where they will grow up to aid some of my readers, I will consider that these hints have not been written in vain, and will feel that I have taken a few more steps, although they may be feeble ones, in the direction early marked out in my career, that my every effort would be toward a higher and a better class of electrical construction and equipment.

The Water Works of De Kalb, Ill., Operated by Electricity.

A novel water works plant has recently been installed at De Kalb, Ill., by the Gould Company, Chicago. The plant is operated entirely by electric motors, and has the credit of being the first of the kind erected in the west. It is complete in every respect, and furnishes both fire and domestic service. The accompanying illustration shows a view of a part of the pumping station, the connection of the pumps and motors and the small space occupied by the plant. There is no boiler or engines about the works, and the building was erected only for the accommodation of the pumps and motors.

The water works plant, aside from the pumping machinery, consists of a 10-inch drilled well, a reservoir, mains and a standpipe. The water is pumped from the St. Peter rock, 250 feet below the surface of the earth, with a deep well pump, driven by a 30 horse power electric motor, and discharges into the reservoir near the pumping station. From here it is pumped into the mains by two 10x12 Gould triplex electric service pumps. The connection of mains to standpipe is such that the standpipe takes what water is not consumed during the time of pumping, and gives it out to the mains again when pumps are idle. The pumps, as stated above, are Gould's triplex electric pumps, having three pistons, 10 inches in diameter, by a 12-inch stroke in duplicate, each pump being directly connected to a General Electric Company's 70 horse-power multipolar slow speed motor with rawhide pinions. The speed of motors is 470 revolutions per minute.

The capacity of each pump is 500 gallons per minute, running at 43 strokes. The pressure that pumps work against for domestic service is 60 pounds, but as the plant is designed to do fire duty also, each pump is sufficiently strong to stand 125 pounds' pressure. In case of fire, in order to get this pressure upon the mains quickly, an automatic device for closing the standpipe connections from the mains is used. The capacity of these two pumps is far in excess of the city's requirements for domestic duty and to keep them in perfect order for all service, one pump is run every alternate day to pump water for domestic consumption, thereby giving assurance that both are always in working order. In case an alarm of fire is turned in one pump, or both, can be put into service instantly, against a pressure of 125 pounds, with a combined capacity of 1,000 gallons per minute, or whatever the exigencies of the case may demand, thus giving a duplicate and extremely safe plant upon which to depend in all cases.



THE WATER WORKS OF DE KALB, ILL., OPERATED BY ELECTRICITY.

The motors were especially designed for this plant, and are giving very satisfactory service, showing in the tests made of the plant by the consulting engineer an efficiency of 80 per cent at half load and 90 per cent at full load. The pumps also showed on the tests an efficiency of 78 per cent at full load and 66½ per cent at half load.

The current to operate the motors is furnished by the De Kalb Electric Company at 220 volts. Five main feeders are run from the central station to water works house, a distance of 2,000 feet. These are distributed upon two independent pole lines to assure absolute non-interference. As there are three motors to be operated the three wires are connected so that they use the other two as common returns. The starting boxes are all in the electric station, and all machines are stopped and started from there, a distance of one-third of a mile from the pumping station. As the De Kalb Electric Campany gives 24 hours' service, it is necessary only to throw a switch to have pumps in immediate operation when a fire alarm comes in.

It is quite conservative to say that no other city in the United States of the size of De Kalb has the same ability for quick fire service, or such a volume of water at instant command as this city has. We might add that the contract between the city and the De Kalb Electric Company provides that the city pay them 4 cents for each 1,000 gallons of water actually pumped, and the electric company also assumes all the care and attention of the machinery. From the point of economy it can easily be seen from these figures that this plant is an extremely satisfactory one to the city, as all expenses for labor, fuel and cartage, as well as all other incidental expenses necessary to sustain a pumping plant, are obviated, and the economy of electricity and a triplex pump for city water works is clearly demonstrated by this plant.

This machinery was installed and accepted under the directions of Daniel W. Mead, consulting engineer, Rockford, Ill. The sale of this plant was arranged by Mr. William A. Swaby, who personally superintended the delivery and erection of the plant.

The Electric Railways of Havre.

The first railways of the city of Havre, which were built about twenty years ago, were operated by horses. Street railways were then not as common in Europe as now and the lines then in operation were considered a great improvement. The comparatively recent change to electric power has kept these lines up with the times and gives an excellent system of urban transportatation between such parts of the city as are reached by the lines.

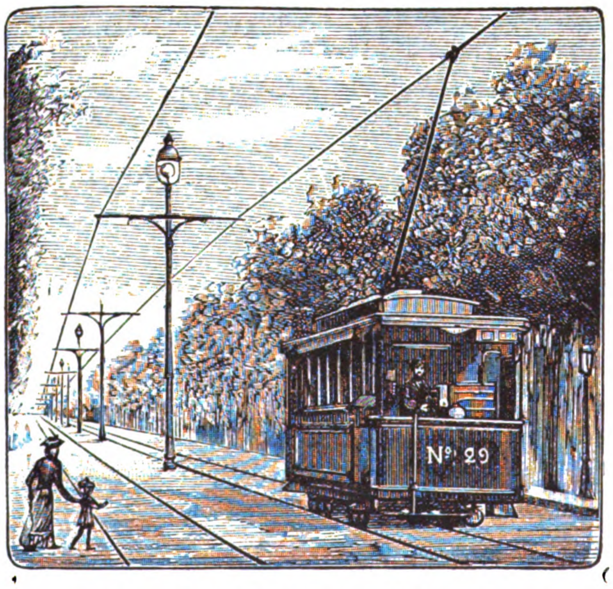


FIG. 1.—THE ELECTRIC RAILWAYS OF HAVRE.

The railway system comprises four main lines. They reach the four quarters of the city and run along the favorite boulevards. The longest line is about three and a half miles long and is double track the entire distance. The second traverses the cours de la Republique, the boulevard de Strasbourg, la rue de Paris, etc. It is a little over two miles long, is double tracked a part of the distance. Another route reaches the northwestern and northern parts of the city, passing through the center. This line is three miles in length and is for the most part double track. A shorter line runs up along the sea on the boulevard Maritime and is one of the most popular routes.

The grades of the line average less than 5 per cent and the shortest curves have a 60-foot radius. The overhead construction is in many respects similar to that in the United States. The trolley wire is generally suspended on insulated hangers by span wires that reach across the street. The poles are placed inside the curb, a plan that might well be imitated in many of our cities. The poles are iron of a neat design. On the boulevard de Strasbourg the poles are placed in the centre of the street and the trolley wires are suspended from brackets. The poles are also used to support the arc lamps by which the streets along the lines of railway are lighted.

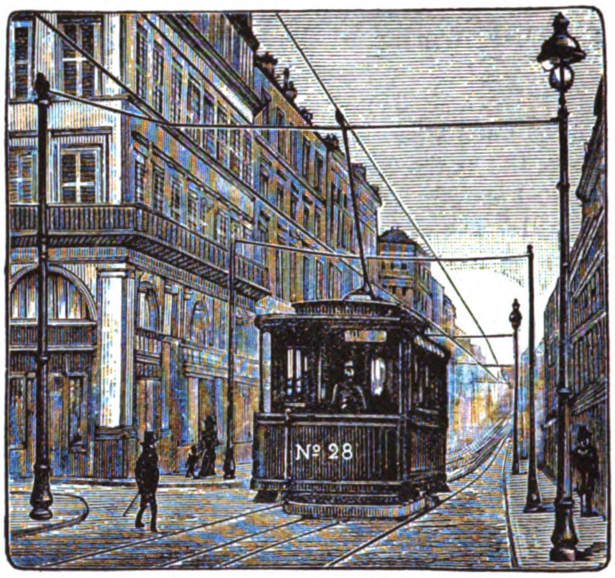


FIG. 2.—THE ELECTRIC RAILWAYS OF HAVRE.

There are forty cars in use and each is divided in two parts equal in size, the one for first-class passengers and the other for second. The former are very elegantly furnished and the car fare is increased 50 per cent. The cars are lighted by incandescent lamps.

A part of the cars are equipped with two motors and the balance with one. All have two controllers, one placed on each platform. The motors and controllers are similar to those used in the United States.

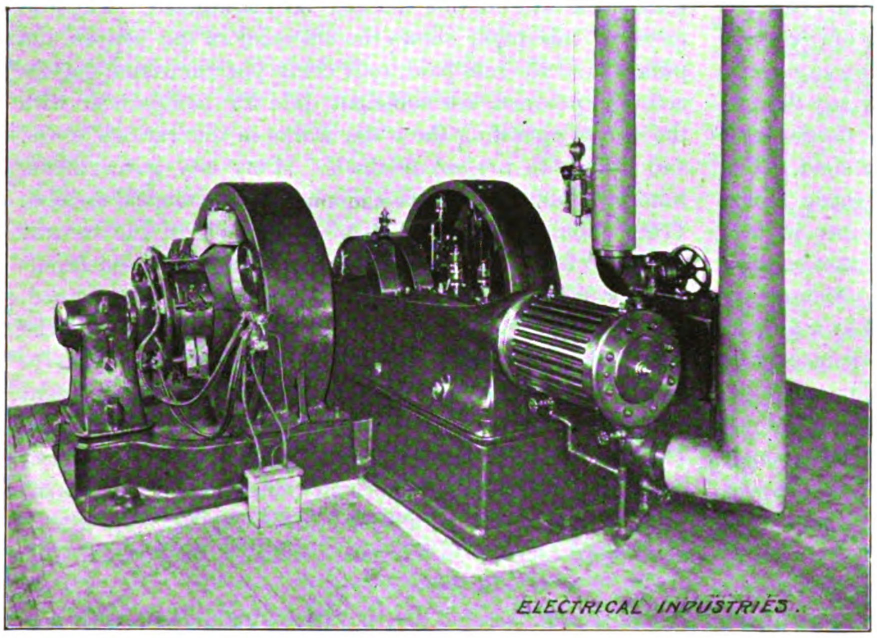
The power station is located very near the centre of the city on la rue Charles-Laffitte. The electrical equipment consists of three 200-kilowatt, 500 volt, multipolar dynamos of the T-H type with a speed of 425 revolutions per minute. The station also contains four 225-kilowatt alternators for lighting purposes. Each generator is run by a Farcot-Corliss condensing engine connected by a system of rope drive. These engines are supplied with steam from a boiler plant of ten boilers. The instruments and connecting devices are mounted on a large switchboard divided into panels.

For the storage of the cars the company has a large car barn, adjoining which is a repair shop where the cars are kept in repair. The motors and electrical equipment are regularly inspected. The repair shops contain everything necessary in the repair of the electrical equipment. The cars are easily run into the barn or out as there is a trolley wire above each track.

Since electricity was adopted on this system the number of passengers carried has greatly increased. The service has been better and the public has appreciated the rapid transportation. The fare is uniform throughout the city. For the second-class and platforms 10 centimes, and for the first class 15 centimes. The accommodations afforded are neat, rapid and low in cost. The success of the change has been unquestioned from the start. The introduction of electric traction is also an evidence of the progressiveness of the citizens of Havre. The first line was opened last July and the other lines were soon after operated by electricity. Nearly all the important parts of the city are reached by the street cars, and the city can thus be seen in a short time by this rapid and cheap method of transportation. The illustrations are from L'Energie Electrique.

Lighting Plant in Bushnell Bldg., Springfield, O.

The electric plant used for lighting a building devoted to offices or other purposes, which are necessarily located near the center of the city, must be of a compact form. Space is most valuable and every foot occupied takes so much from the yearly income of the building. The accompanying illustration shows the lighting plant recently installed in the Bushnell Bldg. at Springfield, O. It occupies very little space, is slow speed and especially well adapted for such an installation. The building is one of the finest office buildings recently erected in the west and its equipment is in keeping with other parts of the building.



LIGHTING PLANT IN BUSHNELL BUILDING, SPRINGFIELD, O.

The installation for electric light was made by the Shawhan-Thresher Electric Co., of Dayton, O., and consists of a 35 K. W. generator, direct connected to a Ball engine. The plant has been in operation for some time and has full opportunity to demonstrate its high efficiency and special adaptability to this class of work. The generator is of the multipolar type, the field ring, which is of steel, being supported on the extended sub-base of engine, to which is also attached the outer board bearing, having universally supported self-oiling journal, which renders the shaft at all times perfectly rigid. The field coils are wound upon spools, slipped over the polar projections and securely held in place by adjustable clamp. The armature is supported upon the extended crank shaft of the engine by means of an adjustable hub, which renders the armature at all times perfectly secure, and though allowing of adjustment, still keeps the armature exactly centered.

The commutator is built upon a bush, which is attached to the armature hub, thus allowing of its being easily removed. It is of small diameter, giving a low peripheral speed. The armature is of the bar wound tooth type, each bar being thoroughly insulated and securely held in position. The generator is so designed as to be perfectly automatic in its action, requiring no adjustment of brushes under variation of load. It is amply proportioned in all parts, obviating all undue heating, so that in no part does the machine become heated more than 75 degrees above the surrounding atmosphere. Both armature and field frame are perfectly insulated from the ground. The engine is a 10 by 12 Ball automatic, running at a speed of 300 revolutions per minute. The unit as a whole is very compact, occupying a very small amount of floor space. It is noiseless in operation and is neat and compact in appearance.

Electric Power Displaces Steam.

The announcement recently made that the New York, New Haven & Hartford railroad would use electric power on some of its branch lines has created a considerable interest in the subject. The road is to try electric power on the Nantasket Beach branch, which is about seven miles long with a summer traffic that is especially heavy. The equipment has already been contracted for and the installation will be made immediately. If this section proves a success, other sections will be equipped in a similar manner. The cars are to be fifty feet in length and will open at the sides. The motor cars will be fitted with two 100 horse-power motors and will draw one coach as a trailer. The company is also having built two 30-foot baggage cars. This road has a large number of such branch lines that are feeders to the main lines and it is expected that this move is but the beginning of a large system of electrically operated roads.

Tesla's Laboratory Burned.

The laboratory of Nikola Tesla was burned on March 13th with its entire contents. The building in which his laboratory was located was at 33 and 35 South Fifth Ave., New York. The entire building was consumed, and the contents are a total loss. The fire was discovered between two and three o'clock in the morning. The fire gained such headway that it was soon beyond control. The experimental apparatus, models, plans, etc., in the laboratory, whose value can not be estimated in dollars and cents, were destroyed. The loss is felt not only by the wonderful investigator and inventor himself, but by the world at large. The work which was being done by Tesla, received the attention of all scientific and technical persons. A new laboratory is being fitted up and the work taken up again.

The citizens of Carbondale, Pa., are about to organize a company for the establishment of a telephone exchange. Parties who are prepared to furnish a complete and reliable system, can obtain further information upon application to A. P. Trautwein, secretary of the Board of Trade.

Electrical Industries.

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CORRESPONDENCE, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

ADVERTISING RATES upon application.

THE many advantages in the electric distribution of power in factories are becoming more generally recognized. Whether the factories are close together or are scattered over a considerable area electric motors and lines of distribution are easily adapted to the situation. A central power station at which the power for the entire plant is generated, receives the fuel and supplies and can be under the direct supervision of an experienced man who could not care for a number of small plants. The expense of the entire plant is easily watched and expenditures are cut down to reasonable figures. The amount of power used by any department and its share of the expense is easily determined. There is no system so flexible nor so easily handled. The manner of driving the machines by the electric motor varies with the kind of machine and the number in use. The matter of speed is now so well regulated that counter shafting is not necessary on that account. Motors are mounted on machines and the speed regulated by a gear or two. Where a number of machines are within certain limits the saving in the larger sized machine over a number of smaller ones would be sufficient reason for the use of shafting. Where the machines are used but a small portion of the time the electric motor effects a great saving as it is easily and quickly stopped and started and what shafting there may be is operated only when the machines are in use. In the design of an electric system of distribution and operation for factories or shops an intelligent study of the situation must be made. Motors must be of an economical size and arranged to operate one machine or a group of machines most economically. For the transmission of electric power the alternating current has received the most attention on account of the long distance systems planned and on account of this attention the many advantages of the direct current for shorter distances have been almost unnoticed by the general public. Within reasonable distances the alternating current has no claim to consideration, while the direct current fills every requirement. The voltage at which the current is distributed depends on the distances to be covered and such other conditions as lighting, etc., as may appear in the particular plant. In the December number of ELECTRICAL INDUSTRIES appeared a description with illustrations of a system of electric power distribution using electric current at 500 volts. In this issue is described a plant where the voltage of the current used for power is 220 volts. A comparison of the two systems shows that they are well adapted for the particular service. The first plant covers much the larger territory and there is less loss in the lines with the 500 volt current. The second plant is more compact, the different factories covering a much smaller area. The electric motors used in these plants as well as in numerous others meet every requirement of the service. They require little attention, occupy a small amount of space, are easily adjusted to the work and rarely get out of order.

CENTRAL station men find the field constantly extending in which electric power is supplied. New uses for the electric motor are bringing it in greater demand every year. On another page of this number will be found a description of the water works at DeKalb, Ill., which is operated by electric motors, the current for which is furnished from the central station of the DeKalb Electric Co. This plant is the first of this kind installed in the west if not in the United States, and is worthy of the attention of those engaged in the commercial production of electric power. A power load of this kind is a very desirable one for a central station, with the exception that an unexpected alarm of fire is liable to throw an extra load on the station during the heaviest load of the day. This, however, would occur rarely, and possibly never. The water works do not require a constant pumping, the standpoint furnishing during a certain part of the day the supply of water. This period can be arranged so as to come at the time of heaviest lighting load, and a more uniform load will in this manner be maintained. The test made of this plant shows the efficiency of the motors and pumps, and the rate paid, four cents per thousand gallons actually pumped, are sufficient data for comparison with the cost of operating the water works in the various towns and cities with present methods. Many city governments would undoubtedly find it a much more economical method. There should be no question of the ability of the central station to furnish the power at a lower rate than the separate power plant of the water works could be maintained. In small cities where the central station has no day load the operation of the water works would furnish a nucleus to which could be added, without much trouble, a sufficient number of motors to give the station a paying day load. The fixed charges against the equipment, such as interest, taxes, etc., are not increased, and consequently the returns from the day load do not have to be very heavy to give a substantial increase in the net earnings of the station.

THE recent decision in the Bate refrigerator case has drawn considerable attention to the patent laws and the protection they give the American inventor. The laws have been enacted to foster invention and indirectly the growth of the industrial arts, by granting to the inventor a monopoly of his invention for a term of years. Without such a protection there would be little inducement for anyone to follow the vocation of an inventor. The laws grant to the inventor a monopoly for seventeen years, which is, however, subject to several conditions. Should he receive a foreign patent before his American patent is issued, the life of the American patent is limited to that of the foreign patent. In this manner the life of his patent is shortened by several years. It is through no omission on his part but because in seeking to extend his monopoly he has received a foreign patent before the American. It might be because of a previous application or that the foreign patent office was more expeditious in granting patents. While this may seem unjust and is, if seventeen years is the legal life, ordinarily, of an American patent, yet it is a check in a way on withholding the issue of a patent. For some reason it might seem desirable to the inventor to withhold the application for a patent or to use his influence to delay the issue of a patent, which would, were this ruling not made, give him a monopoly reaching over a longer period. It avails little in this direction since the danger of losing his patent would usually deter an inventor from attempting to delay the issue of the patent. The present law really opposes the intent of its makers by placing at a disadvantage the American inventor. Its effect seems to be to make it extremely difficult for an inventor to get his rights in the different countries. If he gets his American patent first he imperils his prospects of getting foreign patents. If he gets his foreign patents first he shortens his monopoly in America to the time of the shortest foreign patent.

Municipal Lighting in Chicago.

The March number of the Political Science Quarterly, contains an article under the above heading by Mr. Wm. J. Meyers. A brief history of the origin of the present municipal lighting plant introduces the subject, the real cost per lamp of the arc lamps operated by the city of Chicago. Regarding the report of the superintendent the writer says: "His analysis, an abstract and résumé of which is published in connection with his report to the fire marshal of the city for the year 1893, is concerned only with the money outlay of the department, and fails to take into account the various items of superintendence and office expense, water expense, interest, taxes, insurance and depreciation."

The water consumed is estimated at seven pounds of water per pound of coal, which gives a monthly consumption of 1,592 gallons. The cost to private corporations at 8 cents per thousand gallons to customers using more than 165,000 gallons per month would make this expense about $1.41 per lamp per year. The interest allowance at 3½ per cent on cost of investment is placed at $21.70 per lamp per year. Taxes are estimated at three quarters of one per cent of the value, making an average charge per lamp of about $4.65 per year. The comptroller's report for close of 1892, places the value of the housed property at $229,421.32, which includes buildings, machinery, tools and supplies. Insurance at one and one-half per cent on half valuation, amounts to about $1.55 per lamp per year.

The items of depreciation, five per cent on the steam plant and ten per cent on the electrical equipment, are $4.30 and $37.51 per lamp. From these items the cost per lamp as it would appear to a private company is estimated as follows:

"To Mr. Barrett's reported expenditure of $96.64 per lamp per annum, there should then be added the following items:

Water	$ 1.41
Interest	21.70
Taxes	4.65
Insurance	1.55
Depreciation of steam plant, etc	4.30
Depreciation of electric plant	37.51

"The total is $167.78, which is nearly the proper amount for comparison with the cost of electric light furnished by private companies. This amount ought to be increased by the average expenditure per lamp per year for bookkeeping and other office expenses, and diminished by the average increase in valuation of real estate per lamp per year, and the accrued interest on the allowance for depreciation. As the allowance for depreciation per lamp per year in this computation is $41.82, the interest on it ought nearly to balance the office expenses, and our total expense of $167.78 would then have to be reduced only by the average increase in the value of real estate per lamp. As no satisfactory means of determining this is at hand, it is impossible to say just what allowance should be made; it could hardly be more than $2.78 per lamp per year, however, so that we may quite safely conclude that the total expense to the city for each lamp it operated in 1893 was at least $165.

"For arc lamps rented for various lighting companies of the city, $175 per lamp per year was paid in 1892, and $137.50 per lamp per year in 1893. The estimated cost to the city of the lamps operated by the city plant in 1892 was given in the comptroller's report for that year as $102.50; this presumably was obtained in a manner similar to that by which the estimate of $96.65 was obtained in 1893. As the plant operated in 1892 was nearly as valuable as that operated in 1893, and the number of lamps (1,027) somewhat less, the actual expense in 1892 must have been rather more than $171 per lamp. It is thus extremely doubtful that the city has saved any money by operating a plant of its own prior to 1893, and it seems very probable that the expense of operation in 1893 considerably exceeded the amount paid for hired lamps."

The writer then endeavors to show what would be the cost per lamp to the city if the plants were operated at their full capacity. In conclusion he says: "Disinterested electricians and engineers with whom I have talked, seem to be of the opinion that the plant is efficiently managed. Business principles seem to be observed in the maintenance of the personnel of the force, and although there is some slight reason to think that the finger of the alderman can occasionally be seen in the appointment of the less skilled workers, such as firemen, linemen and laborers, I have not heard it asserted that the efficiency of the force is thereby impaired, or that inefficient men are retained on account of the manner of their appointment."

An Electric Power Transmission Scheme.

An electric power transmission system of considerable magnitude has recently been projected near Atlanta, Ga. The water-power of the Chattahoochee river near there will afford, it is estimated, from thirty to forty thousand horse-power. A company has been organized to develop this power and transmit it to Atlanta and vicinity. It is proposed to erect dams and power-houses at points nine and thirteen miles distant from Atlanta which will generate 15,000 horse-power each.

The possibilities of this water-power have been considered by local engineers and capitalists for several years, but no effort has been made toward its development until recently. The services of Mr. J. H. Vail, of the Electrical and Mechanical Engineering Company, New York, have been secured as consulting engineer to report on the feasibilty of the scheme. The report recently made was of such a nature that the Atlanta Electric Power Company was organized for the purpose of carrying forward the plan. A number of prominent Atlanta and New York capitalists are interested in the company.

Preparations are already being made for the annual meeting of the American Street Railway Association at Montreal in October. The Windsor Hotel has been selected as the headquarters of the association while in Montreal. The meetings will be held in Windsor Hall, in the same building, and for the exhibits Victoria Rink has been secured. The interests will thus be near together and conveniently located. It is announced that exhibits will be admitted and returned free of duty. The executive committee met recently at Montreal to arrange for the meeting. The program has not as yet been announced, but will be at an early date.

The Future of the Steam Engine.

BY FOREE BAIN.

I think that I am safe in the belief that the most advanced and progressive thinkers, in the active fields of mechanical engineering, will not consider my view in regard to the future of the steam engine or the attitude that it occupies today, chimerically, or that the expression of them is ill-advised. I believe that I am voicing the opinions of a great number of thinkers whose minds and skill are assisting in the incubation and development of the germ that is already known and recognized.

The steam engine has been greatly improved within the past decade. Since the introduction of the electric light it has been refined and worked over in all of its parts and from all possible standpoints and views. Some of the best mechanics which the world has ever known have contributed their skill and knowledge toward the result.

The modern steam engine is not the crude, ill-proportioned device it was 25 years ago, with a wire-drawing governor, slow piston speed and with the use of low boiler pressure. Instead, it is a thing of beauty in its lines and action; it moves noislessly, governs closely; in fact, it is "fine haired" in all of its details of proportion and construction.

A great many attempts have been made to increase its efficiency; in fact, it may be said that every attempt that has been made to improve the steam engine has been directed to some measure toward the improvement of its efficiency. The reward has been microscopic compared to the mountains of labor that has been directed toward this end. The modern steam engine is only slightly more efficient than the engines of 50 years ago. Like the modern maiden she may have been slightly improved in looks, but she is terribly extravagant, but, unlike the latter, she is more easily governed.

As an economical transformer of energy the steam engine has been a dismal failure. Any device which retains only about 10 per cent of the potential energy of fuels is not sufficiently valuable as an economical agent for producing power, to retain a very permanent position in the industrial word.

After half of a century of persistent labor, of the best talent of the times, directed towards the improvement of the steam engine as a transformer of energy, and with the results of this labor so trifling as to be scarcely worth considering, I cannot see that there is much encouragement for the belief that the steam engine will be any further improved, or made a more efficient converter of fuel into power unless some radical departure is made from the old methods.

It may be reasonably asked why the steam engine has been employed at all, if so pessimistic a view is entertained by those who know it best. This question may be answered in one word—its reliability.

As a reliable means for producing power it has certainly been a pronounced success. By this illustration we are led to the conclusion that reliability is more valued in practical application than economy of operation. A high price is willingly paid for power that has the certainty of continuous uninterrupted operation.

Economical operation is determined by a careful consideration of all of the factors which enter into the problem. If continuous operation is of more value than the increased cost of fuel, for a device which is extravagant in the use of fuel but which nevertheless possesses the virtue of reliability to produce continuous operation, then such a device may be cheaper in its use, or more economical in the aggregate than a more efficient transformer of energy, which is not so reliable in its ability to continue in operation uninterruptedly.

It is especially the case where power is used in large quantities that the integrity of the source of power must be unquestioned. The interests depending upon its continuation are usually too great to admit of delays or stops occasioned by the failure of the operation of the power producer. Therefore, it will be found that in most cases the highest practical economy is found consistent with the use of the extravagant but reliable steam engine.

Any device or system of devices which is to be entered into practical competition with the steam engine must possess the qualities of—First: Reliability and certainty of continuous operation; it must be equal or surpass the steam engine in these features. Second: Independence of operation; it must be a primary transformer of the potential energy of fuels into power. The electric motor is not a primary transformer, and is therefore not to be considered as a competitor of the steam engine. Third: It must produce an even, uniform rate of motion, independent of load, and be automatic, to maintain the uniformity of motion under varying load. Fourth: It must show high economy of operation; the efficiency with which it transforms the potential energy of fuels into power should not be lower than at least 50 per cent, or an efficiency about five times higher than that of the steam engine.

It is a mistaken idea, however, to suppose that this efficiency is the sum total of all that is to be desired in a successful competitor of the steam engine, in fact it is the least important of several factors, as enumerated above, here repeated in the order of their importance. First, reliability; second, independence of operation; third, regularity and uniformity of motion; and fourth, efficiency of operation and economical maintenance.

Before discussing the rival of the steam engine, let us see if we can find the objection to the use of the steam engine, and when speaking of the steam engine let it be understood that I include its necessary adjuncts, such as the boiler, furnace, stacks, pipes, heaters, pumps and the many other numerous devices which seem essential to the proper operation of the modern steam plant.

Rising above all other considerations is the element of danger. There is a not a single steam plant in operation using a pressure above 50 pounds that is not a constant menace to the lives of all persons within its environs. Careful inspection is not a sure means to secure absolute protection from the boiler's deadly and treacherous devastation.

There is no well-defined condition that will enable the most expert inspector to accurately determine just how long a boiler may continue in daily use safely. The very methods employed for "testing" a boiler serve to strain it in a manner different to the daily strains to which it is subjected when under steam. The "tests" are made cold, the elements of unequal heat and expansion are not present, the very process of a cold test to arrive at the pressure which the boiler will stand may serve to strain it in a way to so weaken it that it will let go the first time it is subjected to the same pressure when again steamed up; therefore, the "test" does not give you any idea of what pressure a boiler will stand, but rather what pressure it did stand. Some of the most disastrons boiler explosions have occurred within a few days after these "tests" have been made.

The Monocyclic System.*

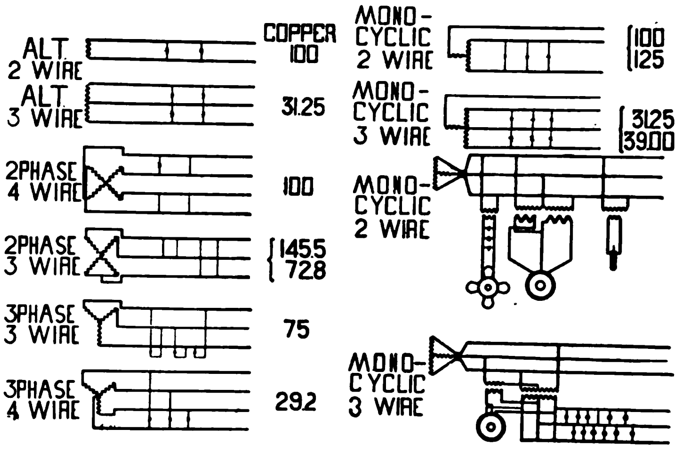
BY DR. LOUIS BELL.

It is the purpose of this paper to call your attention to the various methods of central station distribution, involving motor service on the alternating current system, and more especially to a modified single-phase alternating system which lends itself very readily to a very simple and straightforward distribution of lighting without sacrificing the excellent motor service which makes the true polyphase systems so desirable. For all around central station work, the lighting service is of most fundamental importance, and convenience and economy in this particular must, in a vast majority of cases, be the first consideration. (The author here review the different systems of electrical distribution indicated by the accompanying diagrams.)

It is instructive to glance over this list of alternating lighting systems to see their relative complexity and advantages. It is especially noteworthy that any and every method of distribution that saves copper introduces in some form or other the question of balance. This is the price we pay for reduction in cost of conductors. It has not seriously interfered with the use of the Edison three-wire system; in fact, those most familiar with that system were the first to make light of the difficulty; nor do I think it stands as a valid objection to the use of the polyphase systems in cases where they are desirable, as none of them are more sensitive in the matter of balance than the Edison three-wire system which is now in such extensive and uniformly successful use. We may further note, that in each of the alternating systems where a very great saving of copper is accomplished, a fourth wire is necessary, at least if both lights and motors are to be operated; in each case, however, of trifling size.

Having now looked over the field in general, we may pass to the more minute consideration of the somewhat striking electrical peculiarities of the monocyclic system; peculiarities which, although they do not involve any particular complexity, are yet of decided interest.

The general principle of the system is well shown in this diagram. So far as the main work of the generator is concerned, its winding is closely similar to that of any well-designed alternator. The armature is of the ironclad type, and the winding is made in machine wound coils which are invariably insulated, and can be very readily slipped into place. There is, however, upon the armature a second set of coils of cross section equivalent to that of the main coil, but composed of comparatively few turns, so that the room taken up on the armature is very small, and owing to the shallowness of the slots necessary to accommodate this second or teaser coil, the output of the machine, considered as a single-phase generator, is not affected. This teaser coil is located with reference to the main coil as shown in the diagram. Its place on the armature is midway between the other coils, and the electromotive force generated is in a direction at right angles to that of the principal coil. It is evident, now, that if we connect the terminals of the main coil, we shall get an electromotive force compounded of the two, and in some intermediate direction. In general, by varying the proportions of the two coils, and hence their electromotive forces, we could obtain a resultant electromotive force between their terminals having any angle we pleased with either the main or the teaser coil. If, then, wires are taken upon the line from the terminals of the main coil, and also from the teaser coil, we can obtain from the main line three electromotive forces, two of which are symmetrically situated with reference to the E. M. F. of the teaser coil, and bear to it any phase relation that we please, One of the most convenient arrangements, and that which is most generally adopted, involves such a relation of the electromotive force of the teaser coil to that of the main coil, that we shall have on the line three electromotive forces approximately 60 degrees apart. In other words, the resultant E. M. F.'s between teasers and main coils are each 60 degrees from the E. M. F. of the teaser coil. Such an arrangement is that shown in the diagram. Under these circumstances, it is clear that if one of these electromotive forces were reversed, either in transformers or anywhere in the translating devices, the result would be three electromotive forces 120 degrees apart, one of them having been turned through an angle of 180 degrees. Meanwhile, the relation between the power wire, which is connected to the teaser coil, and the outside wire has no effect upon the electromotive force between these outside wires, since the electromotive force of the main coil itself does not interact with the power wire, except in so far as a portion of it may act with the power wire to form a resultant phase, and electromotive force for running motors. Consequently, so far as lights are concerned, the two outside wires behave precisely like the leads from any other alternating generator, while so far as motors are concerned, we have the power of getting our three electromotive forces 120 degrees apart, and hence have the same magnetic effect as with a three-phase system. The arrangement of lights and motors with this device is clearly shown in the diagram. It is evident that we can take from the outside wires of the monocyclic system either arc or incandescent lights anywhere and to any extent the capacity of the machine permits, working for the incandescents either two or three wire distribution at option. For a motor, two transformers are connected anywhere we please, one between the power wire and each of the outside wires. At this point the resultant phases come into play and the necessary reversal of one of the electromotive forces is accomplished by the very simple and obvious device of reversing one of the secondaries, as shown in the diagram. To the secondary circuit thus constituted, we can connect a standard induction motor which will start and run as well as if connected to a regular three-phase system, or instead of reversing one of the transformer secondaries we may accomplish the same virtual reversal of the electromotive force by reversing one of the coils in the motor itself. We therefore have a system which, so far as lights are concerned, is a simple alternating system; so far as motors are concerned, the dynamical equivalent of a polyphase system. With a differently proportioned formation we could place upon the secondaries two electromotive forces 90 degrees apart if necessary, and then run two-phase motors instead of three-phase motors, if there were any object in so doing. Such an arrangement, however, would be less desirable than that of the quasi three-phase system, for the reason that without gaining anything in the motors we should have to generate a larger electromotive force in the teaser coil, and hence take up more room on the armature with it, perhaps enough to have an effect upon the output of the machine considered as a single-phase generator. It is sufficiently evident that the method shown would not be the only way of getting the same result. For example. in this second diagram a somewhat different arrangement is shown accomplishing precisely the same end. Here our object is to operate secondary mains on the Edison three-wire system, and in connection with them to run motors at any point we please. A large transformer, to which the secondary is connected on the three-wire system, is, therefore, installed, and the secondary mains distributed in any manner we please. A second and small transformer, proportioned to the total amount of motor service desired, is connected as shown in the diagram, and the power wire leading from it is taken through the whole or part of the



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*Abstract of paper read before the National Electric Light Association at Cleveland, Ohio, 1895.

three-wire system. The device is analogous to the arrangement of the generating coils themselves, and the result is the ability to operate a standard induction motor by connecting it anywhere on the three-wire system to the two inside wires and to the power wire. Such an arrangement as this is immensely convenient in distributing power and light in cities where, for example, it is desired to establish an extensive system of secondary mains through Edison tubes, or other convenient underground distribution. It is, furthermore, interesting to know that one is not confined to the use of either two or three-phase induction motors, since a monocyclic generator connected to the primary circuit makes an excellent synchronous speed without the assistance of a starting motor, in this particular being vastly superior to the pure single-phase synchronous machine. But, it may be asked, how about this power wire? In case, for example, of a transmission over a considerable distance before the distributing point is reached, must the power wire be part of the transmission system? In answer, I need only call your attention to the fact that the essential point of the monocyclic system, so far as motors are concerned, is the establishing of an electromotive force bearing the same relation to the system as is borne by the teaser coil of the generator. Consequently, in case of a transmission plant, the main generators at the distant station may be simple single-phase machines, the subsidiary electromotive force being furnished by a synchronous motor or similar device at any point in the system. So we might readily have an extensive transmission with a monocyclic machine in the sub-station of such size as is necessary to furnish current for what motors may be upon the system. The power wire would then run only to the sub-station. Another interesting peculiarity of the monocyclic system, and one which is not without importance in case of an extensive power distribution, is the following:

Under ordinary circumstances, induction and synchronous motors are wound so that the counter electromotive force affects the system in a perfectly symmetrical manner, and the current flows over all the wires with some degree of symmetry in response to the demands of the motors on the system. It is customary, however, in the monocyclic system, to employ motors so wound as to throw a high counter electromotive force into the power wire when the motor is at speed and loaded, thereby reducing the normal current carried over the power wire to a purely nominal amount, and this can evidently be done without sacrificing much in the matter of starting, since at the start all the counter electromotive forces in the motors are zero. We have, then, a motor system of a type really peculiar to the monocyclic system, in that each motor will start under the same conditions of impressed electromotive force as if it were a polyphase motor; while, when at speed and loaded, it would be operating virtually as a single-phase machine. If, however, it were overloaded so that it would tend to slow down or stop, sufficient energy would flow over the power wire to bring it back to speed, just as if it were a polyphase machine. This is only one of various interesting ramifications in the system when developed to meet special conditions.

The connections shown in the diagram, however, are those of the most direct applicability and probably which would be most extensively used for central station service. At this point it may be appropriate to ask what is the advantage of such a system. It evidently secures exceedingly marked advantages in the ability to operate the lights on existing circuits or with the simplest possible kind of distribution, and at the same time to run at any point in the system synchronous or induction motors of well-tried and familiar types. The question can be readily answered; in fact, the question is almost obvious. The price which we have to pay for this advantage is the installation of the power wire which necessarily adds something to the weight of copper in the system and to the trouble of installation. Under all ordinary circumstances the power wire need be of trivial cross-section compared to that of the other wires, since, as a rule, the energy required for operating the motors from the given central station is small compared with the total capacity of the stations; and further, it is worth remarking that the monocyclic motors, either synchronous or induction, will run perfectly well if the power wire is disconnected after the power wire is at speed, operating them as single-phase machines. It is, of course, well known that the single-phase synchronous motor gives admirable results, and it is also true that a single-phase induction motor can be constructed of excellent efficiency and other electrical properties. The only material difficulty in this case is to get the motor to start with a good torque. The monocyclic connection enables this to be accomplished. After the motor is at speed the power wire becomes no longer necessary to successful operation, so that in spite of the necessary existence of the power wire it is easy to see that the additional amount of copper is not likely to be burdensome in central station operation. It would hardly ever be necessary to install a power wire of more than one-fourth the joint cross-section of the others, as given in the diagram, and generally a much smaller wire will suffice.

I have thus endeavored in a brief space to give a good working idea of the monocyclic method of combined light and power distribution which has been devised, and is urged upon the public as specially adapted for the work of central station distribution on account of its unique simplicity in practice. As to what has already been done in the installation of such apparatus, a considerable number of these monocyclic generators are in daily use in central stations, for the most part operating over circuits already established and displacing the higher frequency alternators which had been previously used. They are giving excellent results, and the operation of the motors, wherever employed, has been highly satisfactory.

A Standard Rating for Feedwater Heaters.

The variety of engines in operation, using some less and others a greater amount of feedwater per hour, makes the rating of feed water heaters by horse-power indefinite and confusing. The work, which a feedwater heater is able to do, should not be recorded in what the engine requires, but in its own capacity. While one engine may require as much as 50 pounds of feedwater per horse-power per hour, another high-grade engines might require as low as 15 pounds per horse-power per hour and there are engines in use in every grade between these two. With a view to the general use of a standard rating for feedwater heaters, the Feedwater Heater Manufacturers' Association has passed the following resolutions:

We, certain manufacturers of closed feedwater heaters, in convention assembled declaring

That a better understanding among ourselves and also between each of us and our customers in the matter of rating of feedwater heaters, is much to be desired, do hereby

Resolve—That we believe that the only proper rating for feed-water heaters is one which is based upon the square feet of heating surface contained in the heater. For the purpose of giving practical shape to this belief we do further

Resolve—That we hereby agree that for the future we will in each and every case in which we are called upon to make prices upon heaters, state the exact number of square feet of surface which we are offering; to give further effect to this action we

Resolve—That we will in each and every case, state without reservation both in our printed catologues and in our specifications, the diameter of the tubes, the number of lineal feet there and total square feet of heating surface in each heater offered.

Resolved further—That the secretary be requested to transmit a copy of these resolutions to every manufacturer of closed heaters in the United States.

And we hereby agree to live up to the spirit and the letter of the foregoing and to bind ourselves so to do by our signatures affixed below.

Resolved finally, That the secretary be requested to invite all closed heater manufacturers of the United States to join this association and to subscribe to the foregoing resolutions.

Signed, The Taunton Locomotive Mfg. Co.,
Benj. F. Kelley & Son,
Wm. Baragwanath & Son,
The Goubert Mfg. Co.,
The National Pipe Bending Co.,
Robt. Wetherill & Co.,
Keystone Engine and Machine Works.

LESSONS IN PRACTICAL ELECTRICITY

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Storage Batteries and Their Construction—II.

BY J. K. PUMPELLY.

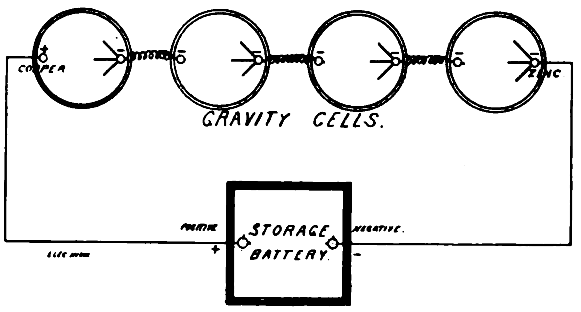
Any one caring to experiment in the making of storage batteries can draw some conclusions from our introductory chapter what line of reasoning he should follow, beginning with the same ideas that Plante had after making himself acquainted with the experiments in this line of Sinsteden, who in 1854 first used oxidizable metals as electrodes in secondary cells. Although the development of secondary currents, such as we have been speaking of, dates from the beginning of this century, as shown in the investigations of Gautherot, Ritter, Erman, Volta, Davy, Bicquesel, Marianini and others.

Plante, notwithstanding the many experimenters before him, has been called the "father of storage batteries," because he carried his experiments much further and developed at last a battery that can be considered commercial, that is, the battery would do work, during its discharge, in fair proportion to the energy exerted in charging it. And today the most successful and durable batteries are made to a great extent on Plante's theories. Although Faure followed him with a different process, which quickened the formation of the cell, and thus cheapened the manufacture, still the theory of transformation and apparent storing of electrical energy in a battery of lead electrodes is the same in both. We will show later on how Faure differed in his process from Plante, and describe the two, both of which are the foundation of all storage batteries as made today. In fact, the Faure process has been changed in no way since first he put it on the market, whereas, the Plante process has been made more commercial through the aid of a more advanced knowledge of chemistry. In converting the metallic lead of the electrodes more quickly into salts of lead, and some mechanical improvements by which the lead plates are prepared and put in a better condition to receive and bear this more rapid process, the manufacture of the batteries has been improved.

Plante's first accumulator came out in 1860, and excited much attention from scientists and educated people generally At this early date he had only primary batteries to charge his accumulators with and for reasons that will be explained later, was forced to use the primary cells, such as the Bunsen cell, to charge each single storage cell. In fact, he had first to make these primary batteries before he could even finish the long and tedious process of forming the lead electrodes, taking months of charging and discharging and reversing—that is, charging the opposite way, before he had an accumulator that could do any practical work. This prolonged process, of course made his first batteries too costly to be in any way commercial. We have little doubt that Plante would have gone much farther in producing a practical and commercial accumulator, had the dynamo been at that time perfected. As his chemical knowledge was varied and advanced, and his labor untiring, our best and most enduring storage batteries today are no more than Plante cells, thoroughly formed and charged with a constant current from a modern dynamo. Our readers can imagine what time and labor Plante devoted to experimenting in this line, when he learns that it was not until 1868 that his battery, composed of parallel plates, was produced. This cell consisted of several plates, closely approximating, but separated at their middle portions by insulating rods. They were placed vertically, and in two series, projections on alternate plates being electrically united. The whole was contained in a gutta percha vessel rectangular in form, and having interior grooves in which the plates are received and held parallel. By this description one can see how nearly Plante came to the improved cell which is now made.

Having noted the important points in the birth and aftergrowth of this mysterious child of electricity and chemistry, we will delay a moment to give the Plante theory of the chemical action of the accumulator by which electrical energy is apparently stored away for future use, and then proceed to describe the manufacture of the storage battery of the present day.

Plante's theory is, that under the action of the primary current, what we understand now as the charging current, the water is decomposed; the oxygen peroxidizes the positive electrode, and the hydrogen goes to the negative electrode.



STORAGE BATTERIES AND THEIR CONSTRUCTION.

Faure's theory is nearly the same. His words are: "The transportation of a certain quantity of oxygen from one electrode to the other, in electro-chemical proportions, and transformation of Pb., that is, metallic lead into Pb_2O and PbO_2 into Pb_2O_3." These are theories for chemical changes produced by the action of the electrical current which was assumed in these early days of storage battery work; assumed, more to quiet the scientific mind inquiring into the mystery of electric chemical changes than to fully satisfy a careful and accurate researcher.

Since these theories do not go far enough by any means to explain all the changes that go on in forming, charging and discharging a storage battery, probably laws of nature obtain which are constantly working in the expending and conserving of energy throughout the universe, under the earth and above the earth and in the animals that exist upon its surface, in the heart and brain of man quite as distinctly as in the accumulator. As we go farther into the subject we will see some of the mysteries, almost unexplainable, that surround the storage battery, and seem to increase and grow up about it as we delve deeper.

Now to return to our newly-made battery of simple lead electrodes, for the charging of which we have only a primary battery, as Plante had when he began his work. The plate shown in this paper explains almost without words the method of arrangement in which the single accumulator is connected to a number of primary cells. A few words will give the reason why so many primary cells should be connected to one storage cell or secondary cell, as the accumulator was first named. The peculiar feature of electro-chemical energy, when excited in a cell by outside electrical energy, is that the cell, after the current has passed through the electrolyte for a short time, develops lively electrical energy of its own, which, counted in volts, can overpower the chemical energy in volts, usually excited in a primary battery, in which chemical decomposition within itself produces electrical energy exerted outside. Thus, a storage battery, even partially formed and partly charged, has an electrical energy of its own of two volts, whereas, a primary battery, as a general thing, produces about half this pressure; hence one primary battery, exerting but eight-tenths of a volt, or even one and eight-tenths of a volt, could not charge a secondary battery, exerting against any greater force a pressure of two volts, and generally, when more fully charged, 2.5, volts. Hence, in using primary batteries to charge storage batteries we are forced to connect in series two or even four primaries with each other, and then this series to one secondary battery, the positive pole of the primary battery to the positive of the storage battery and the negative to the negative, the same way as if connecting to a dynamo for charging. Our next article will go more fully into this matter of forming and charging.

Wrinkles In Electrical Practice.—III.

BY ALBERT SCHEIBLE, M. E.

Interchangeable Measuring Instruments.—It is well known that when we have a right angle triangle (as in Fig. 1) and know the length of two of its sides, we can easily figure out the length of the other side. It makes no difference which two of the sides are given (whether A and B. A and C, or B and C) we can always find the third. This is because there is a definite relation between the lengths of the sides in such a triangle. The same " findability " holds true of any three quantities which have a fixed relationship, so that by knowing any two of them we can figure out the third. In the case just mentioned, the term right angle triangle tells us of this relationship. We have a similar instance in "Ohm's Law," on which we base most of our calculations in electrical work. It states the relation between the three quantities in any circuit—the current, the electromotive force and the resistance. We usually express it by saying that the current in amperes equals the electromotive force in volts divided by the resistance in ohms. But we can invert this rule so as to get either the voltage or the resistance, so that whichever two quantities we have (see Fig. 2) we can easily find the third. Now as we have instruments for measuring each of these three items we can carry the analogy a step further and substitute the readings of these instruments (Fig. 3). Then as we can figure the watts of energy from the other items, and have meters for measuring the number of watts, we may vary the analogy as shown in Figs. 4 and 5.

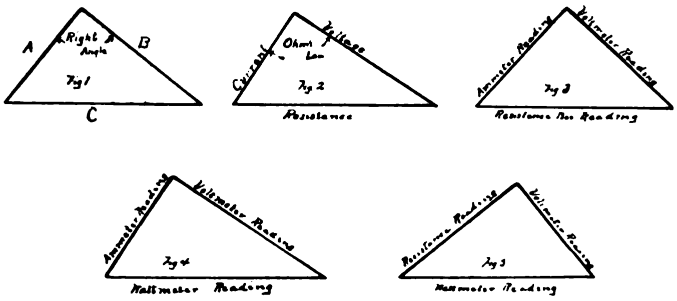


FIG. 5.—WRINKLES IN ELECTRICAL PRACTICE.

No doubt these points are well known in the abstract, but how often do we think of applying them in practical work? When we speak of measuring resistances we think only of using a resistance box or so-called "testing set." But we can also do this by using an ammeter and voltmeter or a voltmeter and a wattmeter. In fact for the best results we ought to be familiar with all three methods so as to use whichever one may be most suitable or most convenient in each case. Thus if one of our instruments is not sensitive enough for the work we can use the other and more delicate one instead. The same holds true in measuring voltage or amperes as well as ohms or watts, and the more thoroughly we understand this interchangeability of our common measuring instruments the better will we be fitted for the problems of practice.

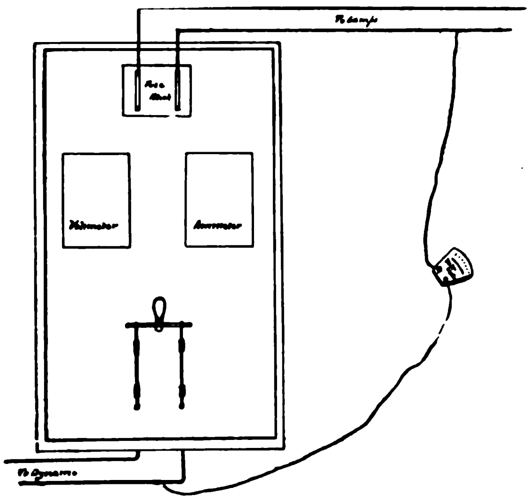


FIG. 6.— WRINKLES IN ELECTRICAL PRACTICE.

Switchboard Losses.—An illustration of this important point of interchangeable instruments is found in measuring switchboard resistances. All opposition to the current before it leaves the station means a waste of electrical energy, and in a well managed plant this should be kept down to a minimum. Yet very few station managers know just what this loss is, and it may be quite a considerable item. Thus the bus bars, switches and fuses all offer some resistance, and it would seem at first thought as if we can measure this resistance with a resistance box or "testing set" when the station is shut down. But this might give a very misleading result. For instance, if we have a rickety switch and a number of loose connections, these may show a very low resistance when measured with a testing set; yet at full load they may heat so as to offer quite a high resistance, and of course this effective resistance, which causes our waste of energy, can only be measured when it is effective. We cannot use a testing set for this, as the dynamo current might interfere with the battery current used for the measurement; but we can get the resistance indirectly by noting the drop in voltage between the terminals of the switchboard and dividing it by the current in amperes. Thus if we find a drop of two volts with a current of 80 amperes, the resistance of the switchboard circuit is one-fortieth ohm, or a very small item. Should we have found 8 volts between the terminals of the switchboard with 80 amperes as before, this would mean one-tenth of an ohm resistance. Then the energy in watts (by the well-known formula C^2R) equals $80 \text{x} 80 \text{x} \frac{1}{10}$ or 640; in this case we are losing nearly a horse-power in the switchboard circuit, and we need to overhaul the switchboard so as to cut down this waste of energy.

Many station managers will be surprised to find out how much of their dynamo output is lost in the station itself, and they can easily measure this loss by this simple use of an ammeter and a low-reading voltmeter. Fig. 6 shows how the connections are made by running wires from the voltmeter to the terminals of the circuit on the switchboard. Of course, both the ammeter and the voltmeter readings must be taken at the same time in order to get a reliable result.

Lamp Efficiency Tests.—The same fixed relationship between the readings of wattmeters, ammeters and voltmeters may help us in measuring small currents when we have no low-reading ammeter. Suppose we have samples, two makes of incandescent lamps and want to find out their relative efficiency, i. e., the amount of current consumed by each at their rated voltage (assuming this voltage to bring each to the same candle power). The simplest way to do this would be the use of an ammeter graduated in hundreths of an ampere, or if we had quite a large number of the lamps we could put on thirty or forty at once, and then use such an ordinary ammeter as we may have at hand. But what if we have only a few lamps of each kind, with no ammeter reading below 8 or 10 amperes? Then another application of our interchangeable instrument analogy will show us a pretty "wrinkle," and one that ought to be more generally known.

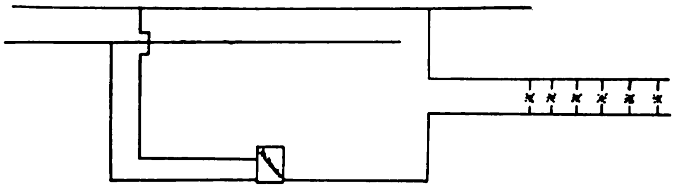


FIG. 7.—WRINKLES IN ELECTRICAL PRACTICE.

The energy in watts in any circuit is equal to the current in amperes multiplied by the electromotive force in volts, so if the volts remain constant, and we double the current, we also double the number of watts; trebling the amperes trebles the watts, and so on. In other words, the watts vary directly as the amperes, so that we can use a wattmeter in place of an ammeter as long as the voltage remains fixed. If we place a wattmeter in circuit with say six lamps of the one kind and then with six of the other we get two readings, which show the ratio between the watts used by each. And if we have seen to it that the voltage was the same in each case, this will also be the ratio between the amperes used by each set of lamps. As the hands on the wattmeter dial move very slowly it might take several hours to get these comparative readings. But as the disc makes many turns for each rotation of the hand on the dial we can get our results more quickly by taking the casing off the meter and counting the revolutions of the disc during a certain number of minutes. Thus, if the six lamps in Fig. 7 cause the disc or drum of the wattmeter to rotate 24 times in a minute, while six other lamps in place of them produce only 20 turns per minute, the first named six lamps take one-fifth (or 20 per cent) more current than the other six. A chalk mark drawn across the edge of the disc or vane will make it easier to count the revolutions.

This method of taking comparative readings of small currents will prove handy in most stations, as these usually have sensitive wattmeters, while they may not have ammeters delicate enough for such work. Of course we can go still further and count the number of turns of the disc, which correspond to a record of one watt on the dial, so a to calculate the actual number of watts and amperes from this. But in doing so we must be careful not to work below the proper capacity of the meter, otherwise the losses due to friction and other causes will lead to misleading results.

Obituary.

MARTIN G. LILLY.

On Saturday, March 2, occurred the death of Martin G. Lilly, of the W. H. Von Mengeringhausen Company, consulting and contracting engineers at York, Pa. His death was very sudden, after being confined to his bed but twenty-four hours. With an excellent education and training Mr. Lilly had entered upon what promised a successful career in his chosen profession. From the academy he entered the University of Pennsylvania, which he left, however, just before graduation, to enter Stevens' Institute of Technology, from which he was graduated with credit in 1886. He was connected first with the Pennsylvania Steel Company, then as assistant engineer on the construction of the Belt Line bridge across the Mississippi. Upon the completion of the bridge he became connected with the above company. He was an experienced and capable engineer, and will be greatly missed.

HENRY C. THOM.

The death of Mr. H. C. Thom occurred at his home at Madison, Wis., on March 16th, after an illness of several weeks. Mr. Thorm was one of the best known central station men of the northwest, and was equally prominent in other industrial, in educational and political interests. He was unaminously elected president of the Northwestern Electrical Association at its annual meeting in January. Having taken an active part in its organization, and filling the position of secretary for several years, he was well-known among the members of the association. He was at different times superintendent of schools, a member of the county board of supervisors and several times chairman of the state republican committee, besides a number of other important positions. These duties he attended to in addition to those of manager and secretary of the Four Lakes Light and Power Co., of Madison, Wis. He was active and energetic in all he undertook, and was highly esteemed by all who knew him.

ROYAL E. HOUSE.

Mr. Royal E. House, inventor of the printing telegraph, died at the advanced age of 81 years, on February 23, at his home in Bridgeport, Conn. Although he invented a number of devices the most important was the printing telegraph system which he worked out and exhibited to the public in 1844. It was his aim in working on his invention to produce a system that would give a record in plain Roman characters and this his machine accomplished. A man of some wealth saw the usefulness of the device and advanced the money for the perfection of the invention. The mechanism when finished was wonderfully perfect and was capable of printing fifty words a minute. Money was easily found for promoting the invention and extensive lines were constructed in the east. The attainments of House in connection with this invention were remarkable considering his advantages and the times in which he worked. Those interested in this invention were not allowed to enjoy the use of this system undisturbed. The Morse interests claimed infringement but in the litigation that followed were defeated.

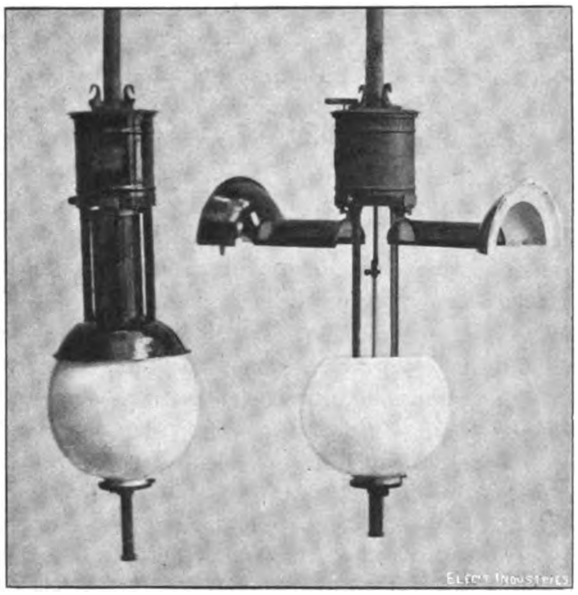
NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

An Efficient Attachment for Arc Lamps.

The attachment illustrated in the accompanying engraving has been found a most useful device as a spark arrester and for protecting arc lamps from bugs and storm. It is manufactured in sizes to fit the standard makes of arc lamps by the S. K. C. Specialty Company of Pittsfield, Mass. One of the important features of the device that should not be overlooked is the reflector at its base, which throws the light downward. It is of a novel design, which not only gives a neat appearance to the lamp but is a most efficient protector.

It is simple and durable and requires no adjustment. The base is built of heavy pressed tin, above which is the perforated chimney, giving complete ventilation to the lamp. This part is mounted on cast brass hinges, with a device that automatically holds the arrester in a horizontal position, as shown while the lamp is being trimmed and the rod cleaned. The base and chimney are spark, bug and storm proof, the joints lapping. When closed it fits tightly to the lamp, and when open is entirely out of the way.



AN EFFICIENT ATTACHMENT FOR ARC LAMPS.

All parts are strong, the edges being reinforced. It is finished in black enamel, baked on, thoroughly protecting it from the weather. The rules of the underwriters call for spark arresters on all lamps used within buildings, as flying pieces of carbon are liable to set fire to inflammable material. This device meets the requirements in every particular and combines the reflector and protector features. The neat outlines it gives to a lamp commends them to customers. The material that collects in the globes of lamps that are unprotected not only obscures light but adds greatly to the work of the trimmers. The device is easily attached to a lamp and is as easily removed.

The Triumph Dynamos and Motors.

The dynamo illustrated in the accompanying cut is built by the Triumph Electric Co., of Cincinnati, O. In the design and construction of this machine there are a number of features that are worthy of mention. The design of the field magnet is shown in the detail cut, and also the arrangement of the field coils. This part of the machine differs considerably from the other types of dynamos now on the market. The field coils are of very simple construction, being wound on a rectangular form of cast iron; as the winding is being made each layer is saturated with a special insulating compound. When the winding is completed the coil and form are placed in an oven and the moisture entirely driven out. The coil is then covered with an insulating and protecting covering and again baked until dry, then placed on the poles of the machine. No part is in contact with the iron, and short circuits are almost impossible.

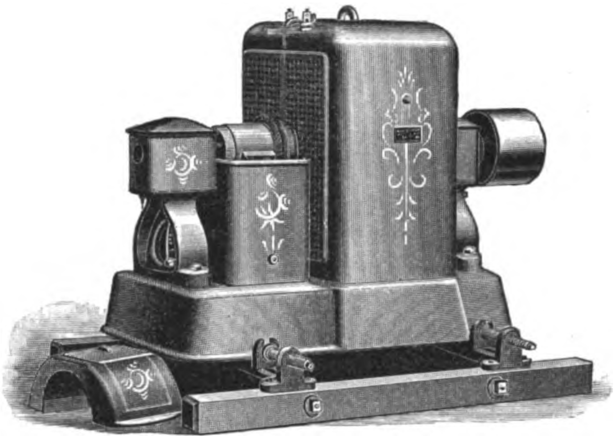
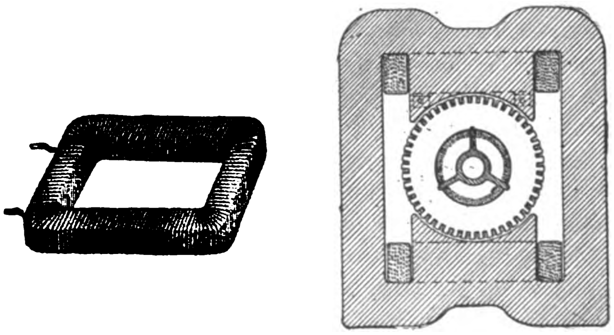


FIG. 1.—THE TRIUMPH DYNAMOS AND MOTORS.

The armature, which is generally considered the most important part of the dynamo, has in this machine received careful attention. The shaft is made of steel and the spider of bronze metal is cast on it. The armature core is built up of thin disks of soft charcoal iron. These disks are toothed on their outer circumference to receive the conductors. A method which protects them and permits the armature to be revolved with a minimum amount of air space between the field pieces. The finely laminated core has no dangerous Foucault currents and insulation used is pure mica. The commutators are also carefully insulated and constructed. The segments are of best tempered copper, insulated by mica. The yoke and pole pieces as above referred to are in one piece of metal. There is consequently no break in the magnetic circuit. The armature is not only protected by the poles and frame but is further protected by plates which, while covering the ends, give a sufficient ventilation. The commutator and brushes are also covered, hence these parts are protected from dust, which in a short time would ruin the commutator. The bearings are of the



FIGS. 2 AND 3.—THE TRIUMPH DYNAMOS AND MOTORS.

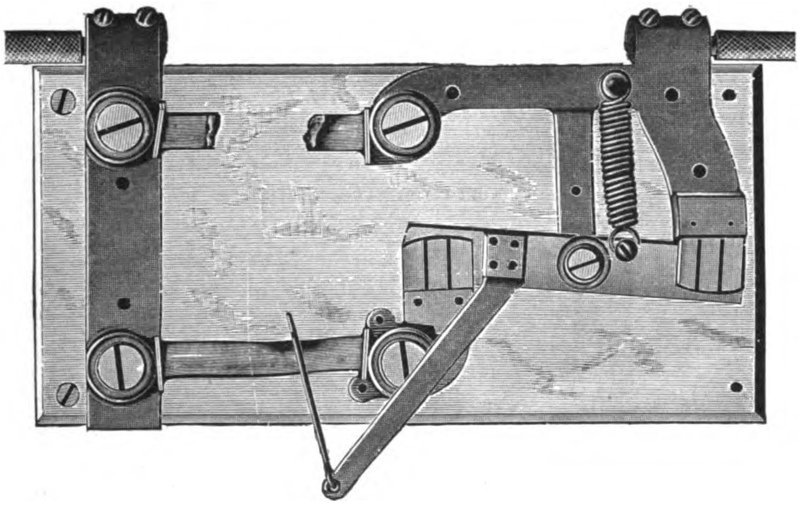
self-oiling type, with large oil wells which are also dust proof. The machine is thus iron clad and on this account is better adapted, whether in motor or dynamo, for use in plants and mills where the air is full of dust and the parts are liable to be injured by the tools or work which is being handled.

The attendance required by the machine has been reduced to a minimum. The brush holders are fixed and immovable. When the brushes are once placed in the holder they need no attention until worn out. The dynamo and motors being almost entirely enclosed there is little dusting and cleaning required. The large oil wells hold a sufficient amount of oil to last some time.

An Automatic Fuse Out-Out.

The trouble often occasioned by the blowing of a fuse is obviated by the device illustrated herewith. It is a single pole cut-out, and is so quick in operation that the almost instantaneous waver of the light is not noticed unless the lamps were being watched. It is automatic in operation, and requires no attention from the one in charge of the apparatus. As will be noticed by reference to the cut, there are two sets of terminals with places for two fuse links, one of which can be cut out of the circuit.

When the fuse links are both in, the upper one holds the lever of the switch bar, throwing the spring in tension. In this manner they will remain until a short circuit occurs on the lines or the fuse becomes impaired and is blown. This releases the bar and the spring throws it into the clips. A new fuse now carries the current in place of the old one. Should the second fuse blow, it is an indication that trouble of a serious nature is on the lines and needs investigation. The new fuse will carry the current if the lines are in proper condition, and will give the attendant time to insert a new fuse in place of the one burned out.



AN AUTOMATIC FUSE CUT-OUT.

A slight waver in candle power will be noticed, but aside from that the lights will give no indication of the blowing of the fuse. The reader will undoubtedly recall the trouble which has occurred after a fuse has blown that was not protected by a device of this kind; the search in the dark for wrench or screwdriver and a new fuse and the time consumed before the lines were again in shape. This device is manufactured by the Wagner Electric Mfg. Co., of St. Louis, Mo.

The general meeting of the American Institute of Electrical Engineers is to be held at Niagara Falls commencing Tuesday, June 18th. A good attendance is expected.

Wagner Transformers and Fuse Brackets.

Something quite new in the line of transformer attachments has recently been brought out by the Wagner Electric Mfg. Co., of St. Louis. It combines an insulated support for the line wires with a specially constructed fuse block.

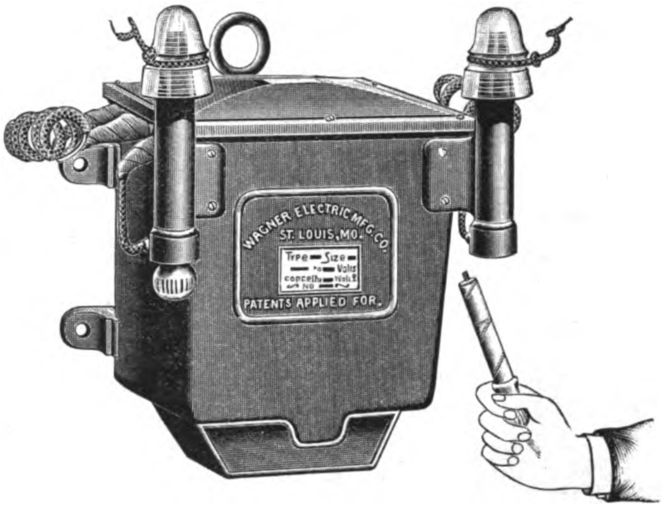

WAGNER ELECTRIC MFG. CO.
ST. LOUIS, MO.
PATENTS APPLIED FOR.

FIG. 1.—WAGNER TRANSFORMERS AND FUSE BRACKETS.

A fuse block should be so designed that it will not allow an arc to to be formed; the fuses should be separated so that one can be removed and replaced without disturbing the other and should also be so designed that a new fuse can be quickly inserted. These qualities and many others are found in the fuse block illustrated herewith.

In Fig. 1 is shown the devices attached to the well-known Wagner transformer. The advantages of the insulated support is evident to all who have hung transformers on pole or building. The same cut shows the fuse plug. These plugs, which are carried in separate cast iron cases, are removed by a few turns of the knob. There is no cover to be removed and no tools are required to replace a burned out fuse. The plugs and shell are made from pure lava, which has been found one of the most refractory substances for this purpose. Repeated tests with currents of high voltage have proven that an arc will not occur on these fuse plugs. The guaranty that accompanies them guarantees them up to five thousand volts.

The insulator bracket is a part of the design to make the transformer easy to put up. A large ring at the back, hooks for cross arms or wall and the support for the wires provides everything for the quick and secure installation of the transformer. In Fig. 2 is shown the fuse plugs and insulator attached to cross arm. They can thus be used when it is desirable to protect a branch running from the main into a building or to a lamp or group of lamps that may be in the street.

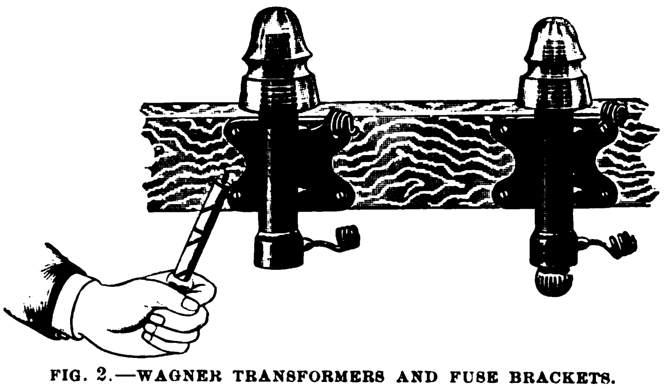


FIG. 2.—WAGNER TRANSFORMERS AND FUSE BRACKETS.

The transformer shown in this connection is known as type D. It is furnished with oil insulation and is wound for 1,000 or 2,000 volts. It is made of sizes from five to five hundred lights. For places where a transformer with dry insulation is preferred the type E is furnished, which is quite similar to type D.

The Monash Pressure Regulator.

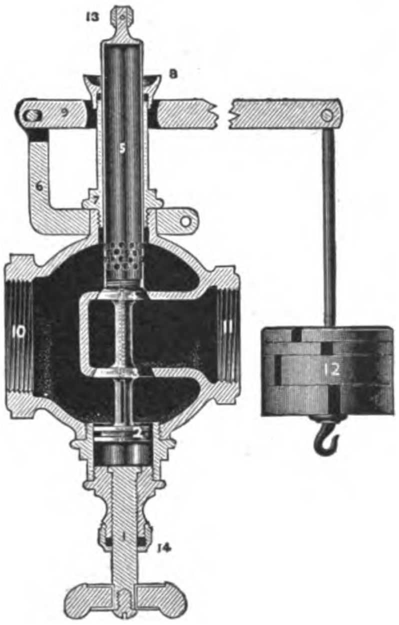


FIG. 1.—THE MONASH PRESSURE REGULATOR.

The accompanying cuts illustrate the Monash pressure regulator or reducing valve, manufactured by the Van Auken Steam Specialty Co., 207 South Canal St., Chicago, of which Mr. C. P. Monash is manager. A number of improvements on this device are herewith described with the aid of the cut, Fig. 1. The device as now placed on the market is said to be unexcelled. In operation the initial pressure entering the inlet end, 11, Fig. 1, passes through valves 3 and 4 to the reduce end, 10, which has excess and controls the bonnet, 5, through the hole at the bottom of the bonnet, closing the valve when the pressure rises above the desired point. The weights which are attached to the bonnet by yoke, 8, and lever, 9, forces the valve further open if the delivery pressure tends to drop below the pressure at which the regulator is set. The valves have conical shaped seats and are ground and constructed so as to be tight under any pressure. The piston which is fitted at the end of the valve stem, prevents all jumping and chattering. The valve stem is made hollow so as to allow surplus of condensation to work off, by means of a slotted hole between piston, 2, and valve, 3.

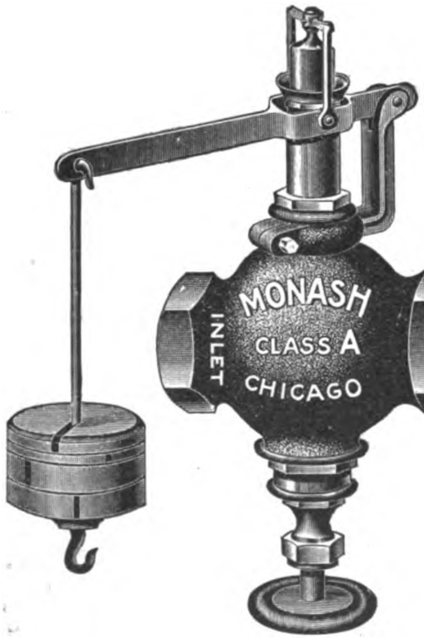


FIG. 2.—THE MONASH PRESSURE REGULATER.

By means of the hand wheel and stem, 1, you can close the regulator off tight, when not in use. The bonnet, valve and steam are all turned together, and are on a straight line, doing away with the connecting links, likewise the piston rods, which constantly wear out, causing lost motion, and lessen areas by the space they take up under the controlling bonnet.

The bracket that holds the weights may be adjusted at any angle, by means of the cap screw. The outlet is made larger than the inlet, and the valves have more pipe area, which gives the pressure a clear chance to distribute itself more quickly.

There are no dash-pots or oil cylinders, no waste pipes, nor diaphragms and no auxiliary valves in this regulator.

This regulator is said to be noiseless in operation and so constructed as to have the greatest controlling power, least friction and least parts to wear out, of any device of this kind, which are the most essential points. The valve is more fully illustrated in a catalogue recently issued by this company.

Economy in Steam Plants.

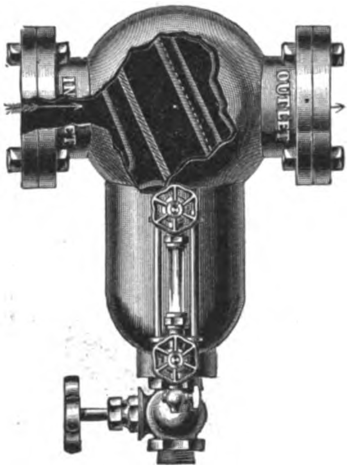


FIG. 1.—ECONOMY IN STEAM PLANTS.

The accompanying illustrations are descriptive of the Stuart steam separators as used and furnished by Hoadley Brothers, engineers of the New England Engineering Co., of Chicago. This separator was the first on the market, and for the past ten years has been operating with a marked degree of success. The past two years of business depression have not been without good results, if they have given users of steam time and opportunity to overhaul and improve their plants, and have shown to manufacturers the necessity of rigid, practical economy, in this direction. In the active competition now existing in all lines of manufactured goods, there is a tendency to the "survival of the fittest," and it is only manufacturers who operate their establishment upon principles of practical economy that can hope for success. Practical economy in steam plants does not mean the smallest possible outlay in first cost; the installation of just enough machinery to furnish the power and perform the work, when this is done at the expense of future results and efficiency. The first cost of a saving article should cut no figure in the consideration of its purchase if the amount to be saved by future use will equal the first cost and interest upon the investment. The first essential principle of economy in a steam plant is to furnish dry steam to the engines. In no way can this be so easily and successfully accomplished as by the use of a Stuart separator.

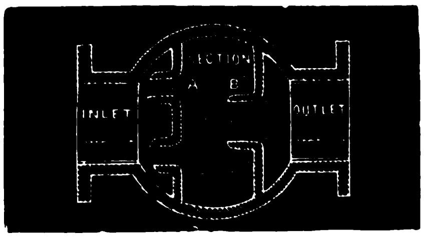


FIG. 2.—ECONOMY IN STEAM PLANTS.

From the accompanying illustrations it will be observed that the special feature of the invention is the separation of all entrained water and grit from the steam. It is found that the steam in passing over the surface or baffle plates, deposits all water and solid matter, which falls by gravity into the receiving chamber and is trapped into the heater. The arrangement of the baffle plates is such that the distance the steam has to travel through the separator is but very little more than the straight line distance from face to face of the flanges, and yet all the steam must come in contact with the baffle plates.

It will be further observed that while the flow of steam from plate to plate through the separator is accomplished in such a manner as to aid the separation and removal of all entrained water and impurities, there is no chance for the steam to again pick up the separated articles and carry them into the engine or pump cylinder. The damage done in one minute by water in the cylinder would amount to more than the first cost of a dozen separators.

The Stuart separator is original, it is simplest in construction; its fundamental principles of separation and collection of the water are the most imitated, and this type is most extensively used.

The Wheeler Feed Water Heater.

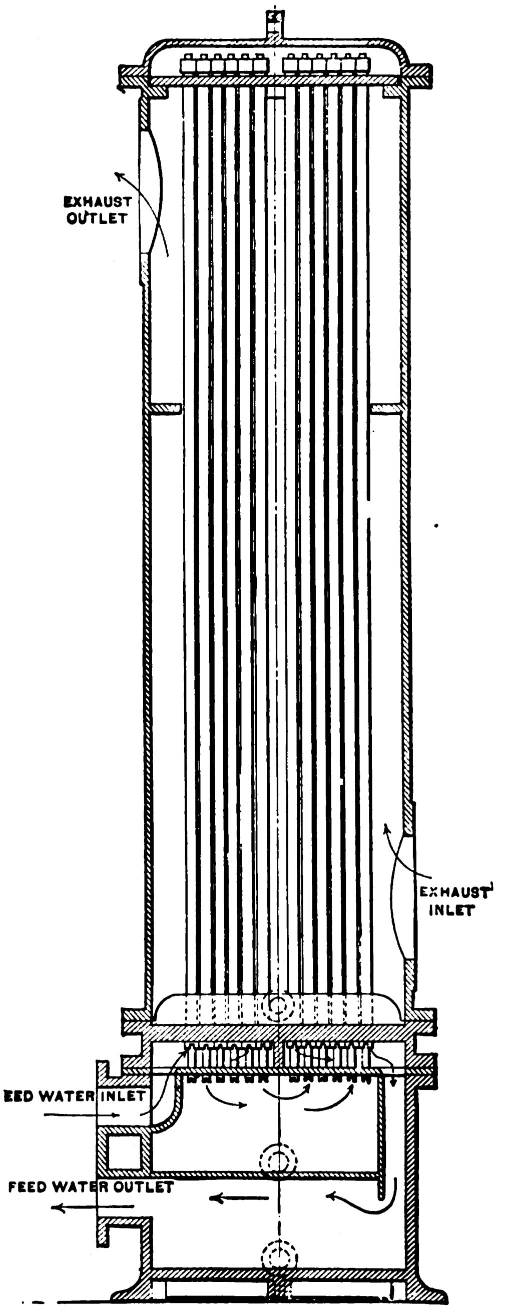
The success attending the introduction and practical operation of the Wheeler double tube system for surface condensers has induced the makers to apply the same principle and similar construction in the design of the Wheeler feed water heater, as herewith shown and described. In placing this approved appliance before the engineering public it is guaranteed not only to be very simple, efficient and moderate in cost, but also to combine the best features which modern practice and long experience suggest.

The Wheeler feed water heater is adapted for stationary or marine steam engines, either condensing or non-condensing, and is built in various sizes, ranging from 50 to 2,000 horse-power. The engraving opposite shows the vertical style of heater; when there is not sufficient head room for this style—or for any other reason is deemed advisable to place heater in a horizontal position—the Wheeler heater is built on the horizontal plan and placed between two sections of the exhaust pipe.

In the improved Wheeler feed water heater the double return system of the feed water is obtained, the feed water traveling four times the length of the tubes, thus insuring the very highest efficiency which can be obtained with exhaust steam. The feed water is split up in many small streams, and by the long travel is raised to a very high temperature before entering boilers. The areas through both the small tubes and through the annular space between the tubes is largely in excess of the area of the feed pipe, thus avoiding undue pressure on the feed pumps. Large settling basins are provided which also form a substantial base for the heater, and also provided with suitable blow-off openings.

As shown by sectional view, the exhaust steam from the engine fills the heating chamber, completely enveloping the exposed surface of the large tubes, and passes out through the upper exhaust opening. The travel of the exhaust steam is direct, and without liability of any back pressure upon the engine. The feed water enters through the upper feed opening, travels upward through the annular space between the large and small tubes, again upward through the second section of small tubes, which are divided by a plate and returns through the annular space between the small and large tubes to the settling basin, or bottom, and thence through lower feed water outlet to boilers. This method insures the most perfect circulation of the feed water. The discharge opening is placed high in settling basin, so that the sediment caught in the latter cannot be disturbed by the current of the feed water as it flows out. At the bottom of the settling chamber is provided a cock for blowing off the sediment. A drain cock is also provided in the lower part of the heating chamber for draining off the condensed steam.

The shell of the heater is made of cast iron and steel plate as preferred. Particular attention is called to the manner in which the tubes are secured, both the larger and smaller tubes are provided with thickened ends with screw threads . These tubes are securely screwed into their respective heads, and perfectly tight joints can, therefore, be guaranteed. The upper ends of the tubes being free, ample provision is thus obtained for expansion and contraction.

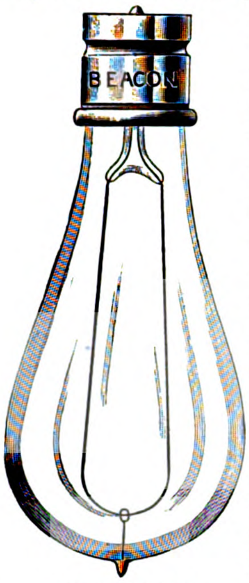


THE WHEELER FEED WATER HEATER.

The tubes are of seamless brass or copper carefully tinned inside and outside. They can be removed for cleaning or repairs by unskilled labor. These tubes are tested to 500 pounds' pressure per square inch.

To remove the tubes for repairs or cleaning they are simply unscrewed by means of a screwdriver tool inserted in the slot cut for the purpose at the end of each tube. These heaters are manufactured by the Wheeler Condenser & Engineering Co., of 39 and 41 Cortlandt street, New York.

The Beacon Anchored Filament Railway Lamp.

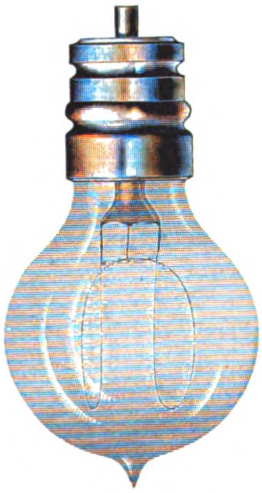


BEACON LAMP.

The accompanying cut shows the anchored filament railway incandescent lamp made by the Beacon Vacuum Pump & Electrical Co., of Boston, Mass. The Beacon lamps have been before the trade since 1890, and during that time many improvements have been made in their manufacture, The lamp as illustrated here shows but the mechanical outlines, while the important methods of construction that give it life and efficiency will be mentioned in the following description. The Beacon lamp is an all glass lamp, and its bulb is exhausted without the use of mercury, a method pursued only by this company. One of the important results obtained by this method is that there is no mercurial vapor present, which is said to be one of the prime causes of the blackening of the interior of the bulb. Lamps that soon blacken have their candle-power quickly reduced and their efficiency is destroyed. The filament of this lamp is made to a certain standard, which is carefully maintained, giving a uniform efficiency and durability.

In the manufacture of the glass work and manner of mounting, the highest development of the art is apparent. The method of fastening the filament in the tip of the lamp is an ingenious method originated by this company. It gives greater strength and firmness to the filament, and much of the strain on the filament is removed. The lamps are made with the different bases in use and for the voltages commonly used with incandescent lamps. The lamps are carefully packed at the factory for shipment, and the safe transportation of the lamps is certain.

New Aetna Incandescent Lamp.

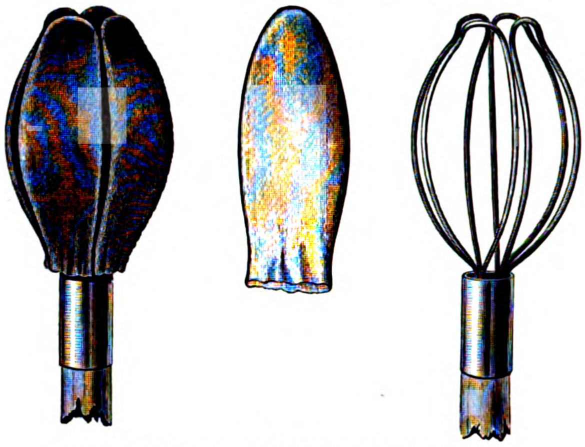


NEW AETNA LAMP.

The lamp illustrated in the accompanying cut is one recently placed on the market by the Aetna Electric Works of Hartford, Conn. One of the most noticeable features is the peculiar twist in the filament. A closer examination of this twist shows that it gives the lamp a number of decided advantages. It strengthens the filament and places the lighting part of the lamp in the bulb of the lamp in a compact space. It also prevents the vibration of the filament and on this account is well adapted for railway and steamboat use. The manufacturers of this lamp guarantee great efficiency for this lamp, having aimed to produce a lamp that would commend itself to users on account of its efficiency and economy. The durability of the lamp has been greatly increased by that twist which prevents its drooping and finally reaching the side of the bulb. This has been a great fault with lamps used in brackets and electroliers which hold the lamp in nearly a horizontal position. The instant the filament touches the glass it is broken in pieces. Nothing of this kind will happen with the lamp illustrated herewith.

McCreary's Incandescent Lamp Cleaner.

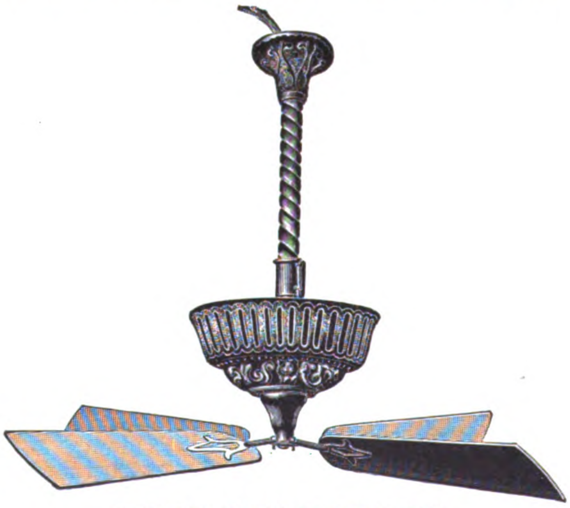
The specialty illustrated herewith, is something entirely new. It is a source of great annoyance to enter a building of any kind and find the usefulness of the incandescent lamps nearly destroyed by the accumulation of dust and dirt on the globes. Sometimes the lamps are not easily reached and are on this account neglected. This lamp cleaner, which has recently been placed on the market by A. A. McCreary, 136 Liberty St., New York, will clean lamps whether they are near the floor or in the ceiling. The construction of the device is clearly shown in the cuts. The wire frame is covered by mittens which are pressed firmly around the lamp and soon remove all dust and dirt. By putting on a rubber friction cover over the mittens the lamps can be removed and replaced. The device thus answers a double purpose. The handles can be extended so that any lamp can be reached. The time required to clean the lamps with this device is very short for a large number. The lamps will give better light and be more satisfactory. This specialty is packed with wool felt mittens and three foot handle.



MCCREARY'S INCANDESCENT LAMP CLEANER.

Improved Bates Electric Fan.

The electric fans manufactured by D. L. Bates & Bro., of Dayton, O., are pretty generally known to the trade, having been on the market for several seasons. The fans which the company are placing before the trade this season contain a number of improvements which add greatly to their excllence. One of the most noticeable of these improvements is the use of four blades instead of two. Improvements in the details have strengthened the different parts and made them more durable. The fans are neatly designed and are finished in either nickel plate or oxidized



IMPROVED BATES ELECTRIC FAN.

copper. They are well adapted for use in any of the many places where fans are now considered indispensable. While the motor is entirely concealed it is well ventilated and runs smoothly. The regulation of the motor is easily accomplished and the sudden starting or stopping of the fan does not injure the motor. Fans are carried in stock adapted for currents of any voltage from 110 to 500. The installation of these fans is the simplest matter possible, being suspended from a hook in the ceiling. They can be taken down and put up again as the seasons change. The orders for these fans as reported by the manufacturers indicates an excellent trade for the coming season.

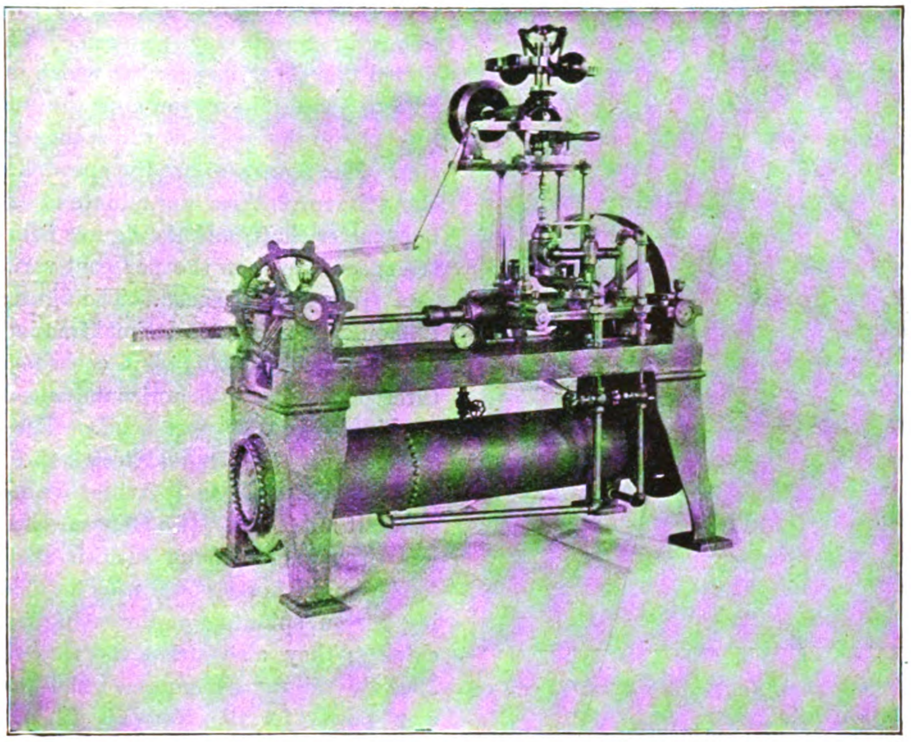


FIG. 1.—LOMBARD WATER-WHEEL GOVERNOR.—TYPE A.

Lombard Water-Wheel Governor.

The Lombard water-wheel governor consists essentially of any hdraulic piston which applies its thrust in either direction to the rack, pinion and gears at the left of the machine as shown in the accompanying cuts. These gears transmit the motion of the piston to the gate mechanism of the turbine. The actuating force which operates the hydraulic piston is air compressed under about fifteen atmospheres (210 lbs. gauge pressures). This air is contained in the cylindrical tank under the bed plate of the governor and the pressure is maintained by a pump operated by the band wheel shown on the back side of the machine in Fig. 1, and on the front side of the machine in Fig. 2. The pressure tank is about one-third full of a thin nonviscous oil and the piping is such that oil, and never air, enters the hydraulic cylinder. It will be noticed that about one-third of the distance from the left hand end of the pressure tank there is a row of rivet heads. At this point there is a tight partition across the tank and there is no connection between the right and left hand end of the tank except by way of piping and through the hydraulic cylinder. In the right hand end of the tank are oil and air under high pressure, and in the left hand end of the tank is a vacuum. The piping is such that the oil is discharged from the hydraulic cylinder into the vacuum tank and is immediately returned by the pump to the pressure tank. In this way a constant pressure and a constant vacuum are maintained. In other words, the oil circulates under pressure in a closed system without any access to atmospheric pressure.

The circulating system is provided with a lever throttle valve and globe valves at various appropriate points; also pressure and vacuum gauges. The centrifugal governor balls actuate a perfectly balanced piston valve which stands in the circulating system. This valve has a lap of one sixty-fourth of an inch, and a motion of that amount one way or the other, as the speed varies, causes the hydraulic piston and train of gears to open or close the gates of the turbine. The mechanism of the valve motion is such that the full amount of motion due to the position of the balls is not used; in other words, the governor does not continue opening or closing the gates of the turbine until the centrifugal balls have resumed their normal position, but stops at such a position that when the various inertia forces have been absorbed, the turbine gates will be in the proper position for the new load.

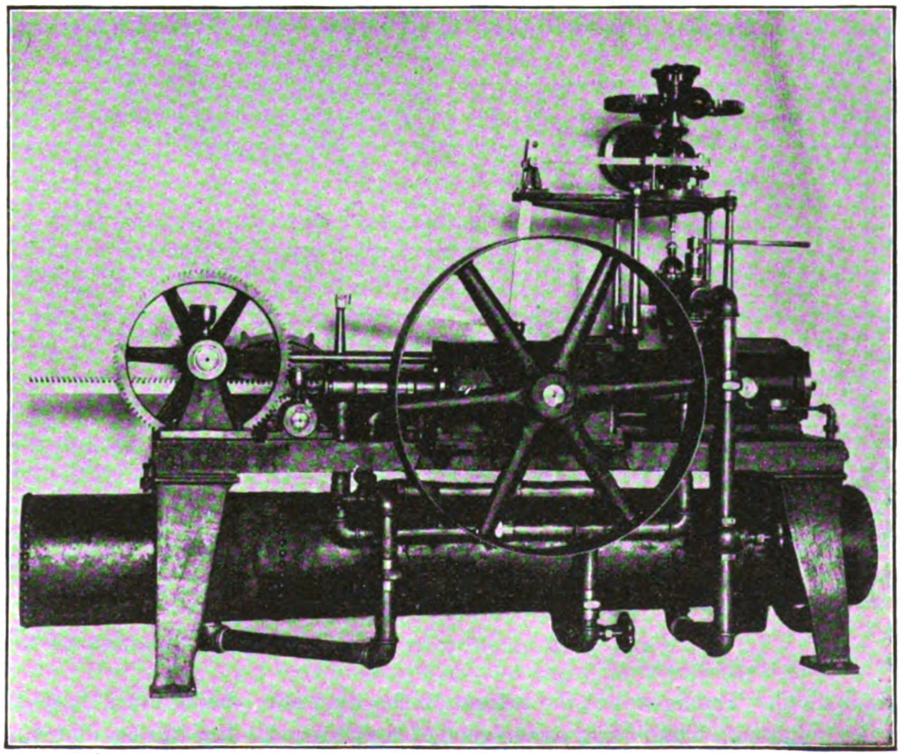


FIG. 2.—LOMBARD WATER-WHEEL GOVERNOR.—TYPE C.

This peculiar motion of the valve is positive, automatic and adjustable, and gives perfect control of the turbine no matter how great the variation of load. By this it is not meant that this governor will hold a wheel to an absolutely constant speed, but it gives a speed regulation that compares favorably with the best steam engine practice, and marks the beginning of a new era in the art of generating power by turbines.

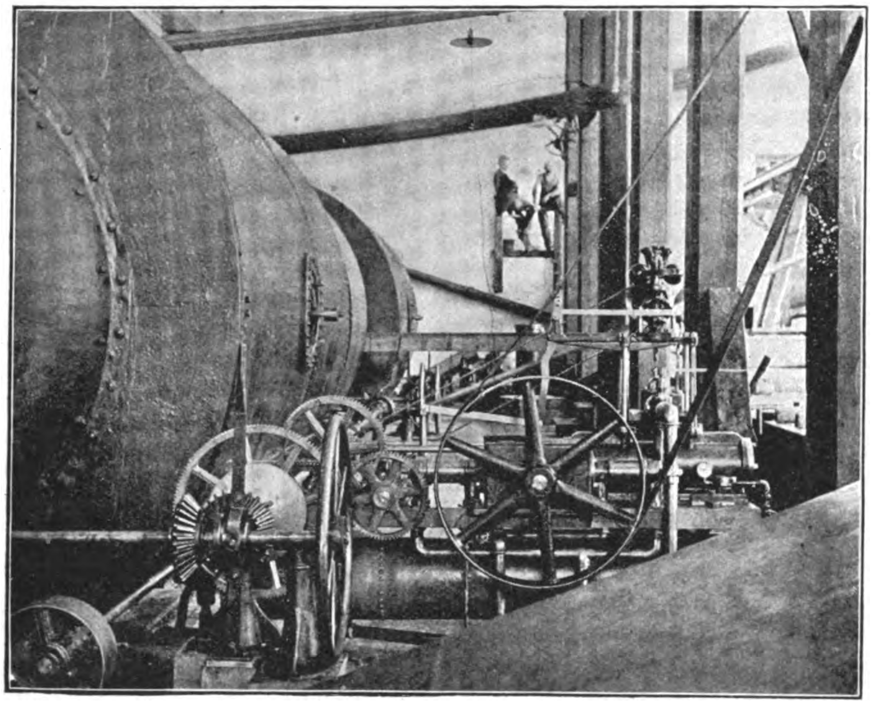


FIG. 3.—LOMBARD WATER-WHEEL GOVERNOR IN WHEEL HOUSE OF BALTIC POWER CO.

One of the best methods of showing what a governor can do in practice is to make readings of load and speed at frequent intervals and plot the same in the shape of a diagram. Such a diagram—taken from the Baltic Power Company, of Baltic, Conn.—is shown on this page. This diagram shows the load in horse-power from 6:20 p. m. to 6:50 p. m. on March 6, 1895. The figures at the bottom of the diagram represent minutes. The figures at each end of the diagram respresent load in horse-power; and the crooked line shows the variation of load each half minute. For convenience the load in horse-power is indicated by figures where the load crosses the vertical lines—that is at half minute intervals. The figures parallel with the load line show the variation in load each half minute. Example: At 6:27 p. m. (see diagram) the load was 57 horse-power. One half minute later it was 273 horse-power, showing an increase of load of 216 horse-power in half a minute; at 6:28 p. m. the load was 446 horse-power, showing an increase of 173 horse-power in half a minute or a variation in load in one minute of 216 + 173 = 389 horse-power. Now by following the vertical lines to the top of the diagram the variations in speed may be seen. The dotted line show the speed at which the wheels should have run and the full line shows the speed at which they did run. The figures above the speed line show the revolutions per minute of the tachometer shaft; and the figures below the speed line show the per cent variation from normal speed. The figures, it should be noted, are decimal fractions of one per cent. This plant consists of three pair of Holmes horizontal wheels working under 35 feet head. These wheels drive two General Electric three-phase generators. At Taftville, five and one-half miles away, two General Electric three-phase motors furnish about four hundred horse-power used for driving cotton spinning and weaving machinery; they also drive the General Electric railway generators, which furnish power for the Norwich Electric Railway (12 miles); likewise they operate a 250 horse-power electric locomotive used to handle freight cars between Tafts on the New York and New England Road and the Taftville Mills.

The diagram shown on this page was taken between 6:20 and 6:50 p. m., when the mills at Taftville were shut down and the load consisted solely of the Norwich Electric Railway and the electric locomotive—the railway load alone being much more difficult to govern than the railroad and the mill combined.

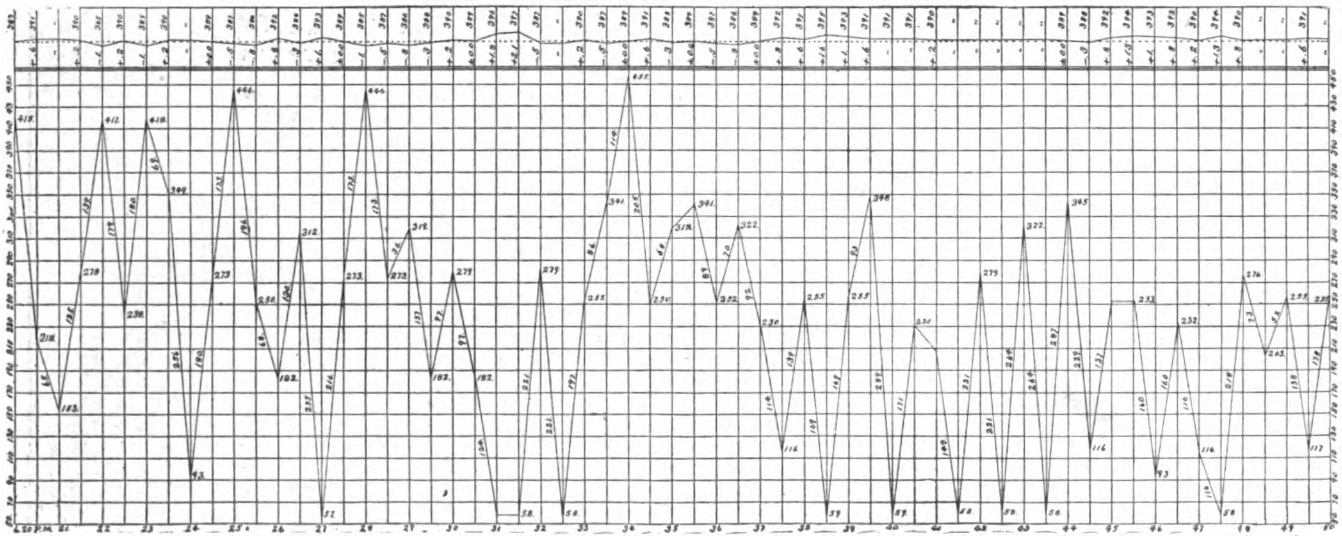


FIG. 4.—LOMBARD WATER-WHEEL GOVERNOR, DIAGRAM OF LOAD AND SPEED.

It should be added that one small incandescent machine is also driven from the jack shaft at Baltic, and no unpleasant variation in the lights is noticed.

The new power house of the Chicago Electric Transit Company, although not completed, is furnishing power for a number of electric railway lines.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

COMMENCED IN FEBRUARY NUMBER.

35. *What is a frictional electric machine?*

It is a machine for producing considerable quantities of static electricity by friction. A common form (Fig. 1.) consists of a circular glass plate which may be rotated between two leather or felt rubbers coated with an amalgam of tin and mercury. When the plate revolves, the rubbers become electrified negatively, and the glass positively. The positive charge is taken from the glass by a number of sharp points which form a sort of metallic comb. The comb and the rubbers are connected with two knobs called "prime conductors," from which sparks may be taken.

36. *Do dynamos for electric lights and motors generate electricity by friction?*

No. These are entirely different and depend upon magneto-electric induction, which will be explained later.

37. *Is the frictional machine used very largely for obtaining static electricity?*

Not for general purposes. It is used to some extent for gas lighting.

38. *What sort of a frictional machine is used for lighting gas?*

There are several forms upon the market, one of which is illustrated in Fig. 2. Most of them contain a hard rubber disc that is turned by a handle. One or more pairs of amalgamated pads are pressed against the disc. The pads and the disc become electrified when the disc is rotated. The charges on them are conducted into a condenser that forms part of the frame. The machine is charged by turning the handle around a number of times in the direction of the hands of a clock, or "clockwise," and then moving it backward a short distance. The disc, rubbing pads and condenser have a certain amount of play inside the case, and when the handle is turned backward, the two side terminals of the condenser come back far enough to make contact with the binding posts *L* and *G* on the case. The condenser will then discharge itself by sending a current or spark through the circuit connected with the machine.

39. *How is this discharge used to light gas?*

It is intended for lighting at once a number of gas jets supplied by the same gas pipe, each jet has a special gas tip, one form of which is illustrated in Fig. 3. This is made of lava or some other insulating material. It carries two metallic wires which are separated a short distance and are so placed that a spark passing between them will light the gas as it issues from the tip. The wires on the different tips are connected "in series," so that current from the machine will cause a spark to jump across between the two wires on each tip, one after the other. The wires are carefully insulated and so placed that sparks will not pass at any place except at the gas jets. After the gas has been turned on, the handle of the machine is turned rapidly and then turned back. This sends current through the electric circuit and causes a spark at each jet, which lights the gas.

40. *Can the same machine be used to light more than one set of the gas jets?*

Yes. For this purpose a "multiple-point switch" is used, by which one terminal of the machine may be connected to any one of a number of circuits. The other terminals of the different circuits are connected together and to the other terminal of the machine. Fig. 2 shows a machine connected with such a switch, so that it may light any one of four circuits.

41. *How many jets may be lighted at once by a frictional machine?*

Frictional machines eight inches in diameter will light from one to thirty-five burners at once. Some machines, twelve inches in diameter, will light as many as one hundred jets at once.

42. *Is there not a frictional machine for single jets?*

Yes. There is a "portable dynamo gas lighter," illustrated in Fig. 4. By pushing a button at the side with the thumb, a small frictional machine in the cylinder causes a series of sparks at the end of the stem. These machines are listed at $5 to $10.50.

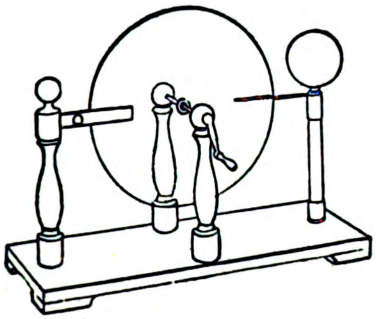


FIG. 1.

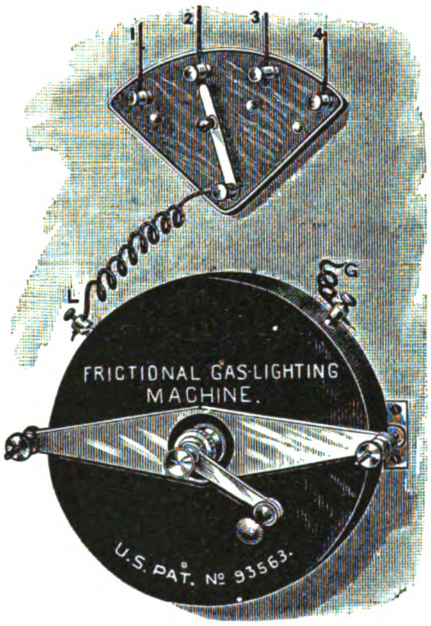


FIG. 2.

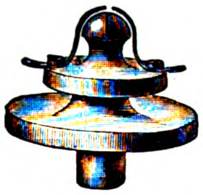


FIG. 3.

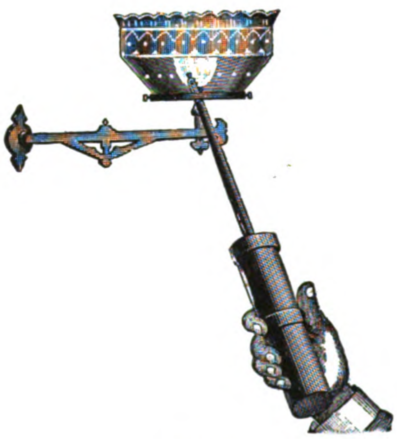


FIG. 4.

43. *How much do the frictional machines for multiple gas lighting cost?*

Eight inch machines are listed at $40. Twelve inch at $75. The special jump spark lava tips are listed at 30 to 45 cents.

44. *Is there not a cheaper method of lighting gas by electricity?*

Yes. When single jets, or groups of less than ten are to be lighted, it is cheaper to use a battery with a "spark" coil. Sometimes "induction coils" are used instead of frictional machines for lighting as many as twenty-five jets at once.

45. *What is an induction coil?*

It consists of two coils of wire wound around a bundle of iron wires. One coil has a large number of turns of fine wire. The other coil has a comparatively small number of turns of course wire and is connected to a battery through a vibrator or interrupter that closes and opens the circuit rapidly, so as to make the current pulsate. The iron core is magnetized every time current flows, and loses it when the current stops. The changing magnetism "induces" in the fine wire coil, a small current at very high pressure, which will jump across considerable distances and may be used for multiple gas lighting or other purposes. These are listed at from $4 to $75.

46. *What is a spark coil?*

It consists of a single coil of several hundred turns of wire wound about a core of iron wires which becomes magnetized when the circuit is opened, the core loses its magnetism and induces a high pressure in the coil, so that a strong spark appears at the place where the circuit is opened.

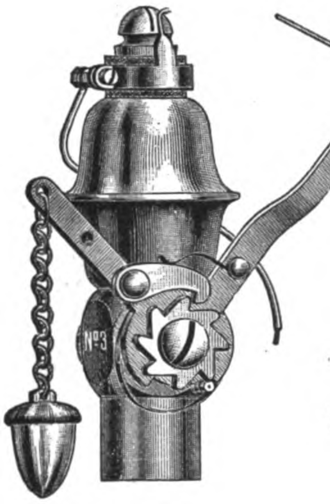


FIG. 5.

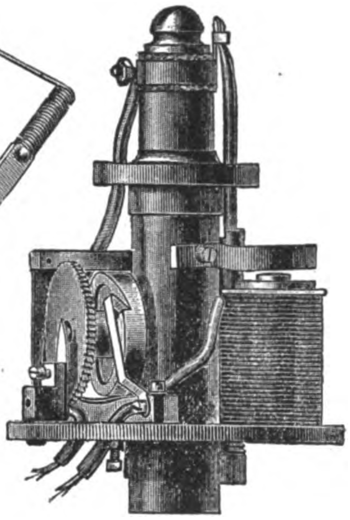


FIG. 6.

47. *What kind of gas jets are used for lighting with a battery and spark coil?*

A number of varieties. Fig. 5 shows one kind of "rachet burner" with a pendant chain. The gas is turned on or off by pulling the chain. The same motion brings the spring wire against an insulated metallic electrode upon the gas tip and closes the electric circuit for an instant. When the spring wire snaps past and breaks the circuits, the spark lights the gas. Some burners require several pulls, so as to give several sparks. Some burners have an independent cock for turning on the gas. Some have an electromagnet that causes an armature to vibrate and keep up a series of sparks at the gas tip, as long as the circuit is closed at a key or push button.

48. *What are automatic electric gas burners?*

These generally contain a vibrating magnet that turns on the gas gradually and keeps up a series of sparks at the tip. If the key is kept closed long enough, the magnet will continue to turn the cock until the gas is shut off again. Some automatic burners have two electric circuits which are operated by two keys. The gas is turned on by pressing a white key, or is turned off by pressing a black key. Fig. 6 shows a burner of this kind.

49. *How are pendant gas burners connected to the circuit?*

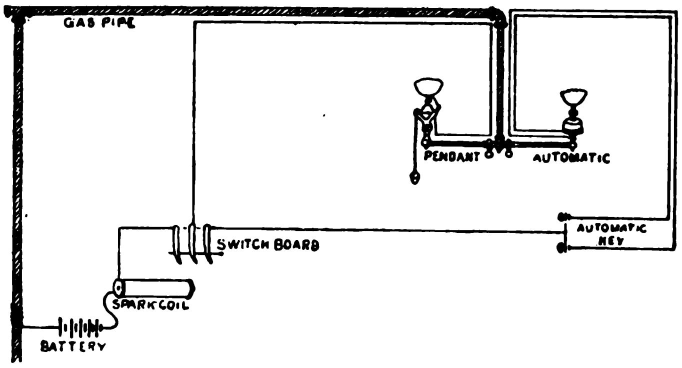


FIG. 7.

One terminal of the battery is connected to the gas pipe and so to the gas burner. The other terminal of the battery is connected through the spark coil to an insulated wire that is attached to the insulated electrode on the tip. Fig. 7 shows the circuits.

50. *How are auomatic burners connected?*

One terminal of the battery and the vibrating arm of the burner are electrically connected with the gas pipe. The insulated wire on the tip is connected to the circuits of the electromagnet. The two wires from the burner go to the two sides of the double key, the middle part of which is connected through the spark coil to the battery, as shown in Fig. 7.

A Few Facts About Belts.

Belts for dynamos should be endless; should be of sufficient width and of good quality. They should be of the proper length and kept at the proper tension, so that they do not slip and a uniform speed of the dynamo is maintained.

Belts should always be kept clean. Dust, oil, dirt of any kind should be kept off the belt, and the belt should also be free from dampness. A little good belt dressing sparingly applied is the proper thing to keep the belt pliable and in good condition. Before applying clean the belt with a damp rag and rub the dressing well into the leather. On thick, heavy belts work dressing into both sides. Thin belts put on grain side.

The B. & L. railway line devices described in the last issue of this journal include the various devices used in overhead electric railway construction, hangers, pull-offs, ears, etc. By a typographical error "trolley ears was made to read "trolley cars." Messrs. Butterworth & Lowe do not manufacture trolley cars. The line devices are worthy of investigation.

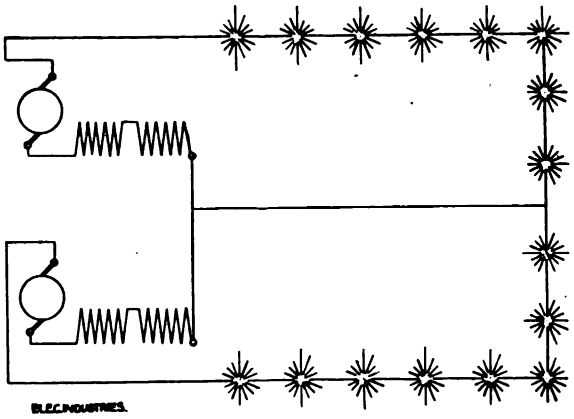
The water works at Canandaigua, N. Y., are to be operated by electricity. The power station is to be located three and one-half miles from the pumping station. The Goulds Mfg. Co., of Seneca Falls, will furnish the Goulds triplex power pumps with 12-inch cylinders and 12-inch stroke. These pumps will have a capacity of one million gallons per day each. The electrical equipment will be furnished by the General Electric Co. Each pump will be driven by an electric motor the current for which is transmitted from the power house on Canandaigua Lake.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

Editor Electrical Industries:

I have two arc dynamos of the same make and capacity, and are very closely regulated for 10 amperes. Can I run the two machines on a three wire system, using the one wire for positive pole and the other two wires for negative when there are no lamps on the wire or positive pole of the two machines? The cut illustrates same.



And could you tell me where the voltage passes an arc lamp, whether through the arc or not, to get to the next lamp, and if there is an instrument made to measure same? The voltmeter shows only 50 volts across the terminals or over the arc. Hence a circuit having 25 lamps registers 1,250 volts at the machine. How will the 1,200 volts pass the first lamp so that the remaining 24 lamps have 1,200 volts?

A Subscriber.

Pittsburg, March 13, 1895.

No; not in practice. While the theory might be all right, it would be almost impossible to balance the two machines and loads. The machines might be of the same capacity and built at the same works, yet they would probably not regulate alike. The slipping of a belt or a difference in handling the load would throw one side out of balance. The burning of the lamps would not be alike, and the current generated would not be equally divided between the two sets of lamps. The advantages of such an arrangement are not clear.

Your difficulty in understanding the series arc light system lies in not having a clear idea of what is meant by a volt. "A volt is the unit of electromotive force or potential difference." It is not a unit of volume, but of force. As an illustration of the electric current passing through the lines and lamps of an arc system, we might say that each of the smallest possible subdivisions of the 10 amperes of current start out from the positive brush of the machine impelled by a force of 1,250 volts. As it passes along the wire it has to expend force to move itself over the wire; when it comes to the first lamp it has to exert a considerable force to do its work at the lamp. Each of these minute parts of the amperes that started out from the machine is getting weaker. If we put the voltmeter from the line beyond the first lamp across to the negative brush it shows a difference of potential of 1,200 volts, which proves that the current has lost in doing the work some of its strength. As it passes farther on the circuit it loses more of its force until it gets to such a point at the machine that it is entirely exhausted. This simply illustrates the relation of the voltage and current or volts and amperes in a series arc system.

Editors Electrical Industries:—I recently came into possession of a set of specifications calling for an electric-light plant, which I understand is for a state building, although the specifications do not say where the plant is to be located.

It verily seems that the perversity of fate has ordained that public institutions should almost invariably have the least possible attention paid to the rudiments of good business principles in the installation of the electric work. The time of the intelligent and high-classed officers is so taken up with red tape and useless repetitions in attempting to conform to some established custom, that they have no time to attend to such matters as the expenditure of a few hundred thousand dollars or so for machinery, which in these modern days has become as important a factor in a building as the very roof itself.

These specifications are extremely broad, as can be judged from the title which reads, "Specifications of Machinery and Material for State Capitol Electric Light Plant." As there are several states you will readily see that the specifications are not meant to be exclusive in any way except that the writer seems to have drawn the line at territories; doubtless this prejudice arises from the fact that he may have visited Oklahoma during the "boomer" period.

The opening clause of the able document calls for a "high speed horizontal automatic engine," which is "guaranteed to stand a speed of 260 revolutions per minute." If perchance, the dynamo should run 261 revolutions per minute, the party furnishing the same would be free from any damage in case the foundation bolts should burst, or the mainspring should get demagnetized. Immediately following this is the statement that "it shall be coupled direct to dynamo." He next calls for a "high speed horizontal automatic engine," which shall be belted to a dynamo. I presume that the able designer called for this on the ground that "variety is the spice of life," and I am sorry that the size of the plant did not warrant another dynamo and engine with rope transmission.

Immediately following this is the remarkable statement:
The following engines are among the best in the market:
The Western Engine Co., Painted Post, N. Y.
Mather Electric Co., Manchester, Conn.
Buckeye Engine Co., Salem, O.
Walker Mfg. Co., Cleveland, O.
Frost Mfg. Co., Galesburg, Ill.

This piece of information will undoubtedly be news to our esteemed friend Tommy Perkins, and it might be well also for Kohler Bros. to insist on their company issuing a catalogue for the superior grade of engine they are supposed to manufacture.

To relieve his mind of the strain of the last statement, under the caption of "Dynamos," he calls for a "compound wound dynamo" for the small engine, and a larger dynamo, which, presumably, is to be connected to the larger engine, although he does not say so. He then states: "In addition to the above addresses are the Thompson-Houston Co., at Lynn, Mass., and the General Electric Co., at Chicago." At this point, our able specifier, who I have since learned is the head janitor of the building, under the euphonious title of "Custodian," leaves the reader in doubt as to whether these companies, who are to be "added to the above addresses," are also supposed to furnish engines, and if he means them to be dynamo contractors, why he does not continue to adhere to his broad-minded principle embodied in the title, and include the Edison General and the Chicago Arc Light and Power Company, and thereby increase his competition (?). Then with the suddenness of a Kansas cyclone he turns his attention to the trimmings required for engines, still retaining the same caption, "Dynamos."

The next page is evidently a part of a proposition made him by some engine company on their regular printed form, as it is consecutive and makes fairly good sense, but in order to not lose his individuality the following remarkable clause is inserted at the bottom of the page:

"The foundation for the engine and dynamo shall be built by the purchaser of brick, sand and cement, and shall be of sufficient length, width and depth to safely and firmly sustain engine and dynamo weight, and all straining to which they are subjected."

The writer has heard of "drawers of water and hewers of wood," but "purchaser of bricks, sand and cement" is a new vocation, and I am really sorry for him if he is going into the foundation business, as he may find it necessary to be something more of a "brick," and to purchase more "sand" and "cement," especially "sand," than he ever required in his previous career.

Following this is a regular stock description of a dynamo which is evidently copied from a proposition which has been furnished him by some electrical contractor.

Then comes the following: "Every bidder is expected to include in his proposal not only everything called for in these specifications, but also any special device or methods peculiar to his system, which will add to the safety, completeness and efficiency of the plant, stating clearly the advantages to be derived from their use."

I presume among the special devices referred to above he intends to inclue "volt sifters," although I am not positive that such is his meaning.

The last clause, which is quite as remarkable as the preceding ones, states: "This contractor must provide all necessary safeguards from accidents to persons or property, must keep sidewalks, etc., free from debris and incumbrance while plant is being erected."

This is the unkindest cut of all; the liberal spirit which the designer has shown all through his specification seems to have culminated in one grasping, selfish request, that the electrical contractor "must keep the sidewalks, etc.," by which I presume he means the building swept clean during the construction of the plant. This statement only emphasizes the fact that janitors are not fit persons to make specifications as they will allow selfish motives to influence them at times. He also says that all "debris and incumbrance," such as the breaking down of a coal wagon or the dumping of a load of hay on the sidewalk, is to be quickly and cheerfully removed by the electrical contractor.

As to just what he means as to "safeguards from accidents to persons or property" I can scarcely imagine, unless he desires a fence built around the dynamo, or some special kind of insulation used on the wires.

He inadvertently fails to mention whether a switch board or any instruments, and some few other details of that description, would be required; but as the plant is to be installed under his care, and as I understand he is to be assisted by the night watchman, who is to be promoted to the position of engineer, I judge that the completed plant will operate satisfactorily and be in every way a success. But what if bidders should send their propositions to the wrong state? And what would occur if someone would send in a proposition from some other company than those mentioned? And what would occur if the "purchaser of brick, sand and cement" should fail to appear at the proper time with his foundation?

Seriously, Mr. Editor, it is an actual crime that the electrical and steam contractors, almost without exception, men of standing and business ability, men whose fitness for their occupation consists in years of training in the mechanical and electrical details of their work, should be called on to make a proposition drawn up in the manner of those under consideration. It simply means that they must plan a plant to suit the building, according to their best judgment; it means the spending of time and money on the part of their companies hobnobing with men totally unworthy of the position which they occupy, and all of this to be done for a state institution, run and controlled by the smartest men of the state, by the best and keenest intellect, who in their desperate struggle to hold their office, and in their efforts to provide snug positions for their various friends, have no time to devote to the interest of the state which they are supposed to serve, but leave these matters to men of inferior intellect. X.

Chicago, March 2, 1895.

FINANCIAL.

The report that the General Electric and Westinghouse companies would pool their interests has awakened a considerable attention during the past month. This report has not been confirmed nor has it been entirely denied. It is believed, however, that negotiations have been commenced looking to such an agreement as will put an end to the expensive litigation which has been carried on for a number of years. Although a number of the most important cases have been settled there are still in the courts a number of suits for infringement of patents. Patents have been the bone of contention between the two companies and it is expected that if an agreement is made it will be concerning the patents of the two companies. The reports circulated by the daily press were such as to lead the public to expect another electrical combine. No reliable information has been given to support it. The effect on the stock of the companies has been noticeable. General Electric gained a few points. Westinghouse was stronger.

Trade during the month has been good comparatively and indications point to a continuation of the improved conditions.

NAME OF COMPANY.	DESCRIPTION OF SECURITY.	AMOUNT ISSUED.	PAR VALUE.	RATE INT.	DATE PAYABLE.	CLOSING Mch. 25.
Miscellaneous Securities.						
American Bell Telephone Co....	Stock.	$17,500,000	100	....	J. Q.	196
" " "	Bds. 1898.	2,000,000	100	7	F. & A.	107
American Tel. & Cable Co... ...	Com.	14,000,000	100	....	....	90
Commercial Cable Co	Com.	7,716.000	100	....	....	130
Chicago Edison Co , Chicago....	Com.	3,000,000	....	8	F. Q.	120
Edison Elec. Ill. Co., Boston....	Com.	2,025,800	100	....	Q. F.	122
" " " ...	C.Bds. 1898.	71,000	100	6	M. & S.	.....
" " "	C.Bds. 1901.	586,500	100	6	M. & N.	.....
" " Brooklyn..	Com.	2,500,000	100	....	Q. F.	108
" " " ..	1st. 1940. }	500,000	100	5	A. & O.	100
" " " ..	Regis. }	....	100	5	A. & O.	.....
" " New York.	Com.	7,938,000	100	....	Q. F.	97½
" " "	1st 1910.	2,562,000	100	5	M. & S.	108
" " Phila......	Com.	1.473,000	100	....	....	115
" " "		....	....	5	....	.....
General Electric Company.	Com.	30,457,000	100	....	......	37
" "	Prf'd.	4,251,900	100	....	....	67
" "	Deb. 1922.	10,000,000	100	5	J.-D.	90½
Gold & Stock Tel. Co............	Com.	5,000,000	100	....	Q. J.	104
Standard Underground Cable Co.	Com.	1,000,000	100	6	Q.	92½
Thomson Elec. Welding Co......	Com.	1,000,000	100	....	....	.....
Thomson European Welding Co.	Com.	1,500,000	100	....	....	.....
Thom-on-Houston Elec. Co .. .	Series D.	120,000	10	....	....	5⅜
United Electric Securities Co....	Com.	1,000,000	100	....	....	.....
" " "	Prf'd.	1,000.000	100	....	F. & A.	....
Western Union Tel. Co..........	Com.	94,820,000	100	....	Q J.	88
" "	Var. Issues	13,088,000	100	7&5	M. & N.	106
West'gh'se Elec. & Mfg. Co	Ass'ting.	5.333,940	50	....	....	36½
" " "	1st Pf.Cum.	3,755,700	50	7	....	50½
Electric Railway Securities.						
BROOKLYN—						
Brooklyn City R. R..............	Com.	6,000,000	10	....	Q.-J.	170
" "	1st Bds.1916	3,000,000	100	5	J. & J.	90
Coney Island & Brooklyn R. R..	Com.	500,000	100	....	Oct. 1.	.....
" " " ..	1st Bds.1909	300,000	100	5	J. & J.	90
" " " ..	Certf. 1894.	300,000	100	6	J. & J.	100
BUFFALO—						
Buffalo St. Railway.............	Com.	5,370,500	100	5	....	57½
" "	Bds. 1931.	5,000,000	100	....	F. & A.	100
BOSTON—						
West End St. Railway..........	Com.	9,085,000	50	..	J. & J.	47
" "	Prf'd.	6,400,000	50	5	J. & J.	77
" "	Bds. 1902.	3,000,000	100	....	M. & N.	100½
LOUISVILLE—						
Louisville St. Railway Co........	Com.	5,000,000	100	....	....	37
" "	Prf'd.	1,000.000	100	5	A. & O.	87
" "	1st Bds.1930	6,000,000	100	....	J. & J.	.....
NEWARK, N. J.—						
Newark Passenger Railway......	Com.	6,000,000	100	....	....	27⅜
" "	Bds. 1930.	6,000,000	100	5	J. & J.	93½
NEW YORK—						
Union Railway Co...	Com.	2,000,000	100	....	....	120
" "	Bds.	2.000,000	100	....	....	105
PITTSBURGH—						
Duquesne Traction Co....... ...	Com.	3,000,000	50	....	....	29
" "	Bds. 1930.	1,500,000	100	5	J. & J.	103
Fed. St. & Pleas. Val. R. R.......	Com.	1,400,000	50	....	J. & J.	21
" " " " "	Bds. 1919.	1,250,000	100	5	J. & J.	102
Pittsb'gh, Aleg. & Man. R. R.....	Com.	3.000,000	50	....		38
" " "	Bds. 1931.	1,500,000	100	5	J. & J.	103¾
Pittsburgh & Birming. R. R.....	Com.	3,000.000	25	....	......	13
" " "	Bds. 1929.	1,500,000	100	5	M. & N.	95
ROCHESTER—						
Rochester Railway Company.. .	Com.	5,000,000	100	....	....	38
" " "	Bds. 1930.	3,000,000	100	5	A. & O.	95
ST. LOUIS—						
Lindell St. Railway.............	Com.	2.500,000	100	....	Q.-J.	106
" "	Bds. 1910.	1,500,000	100	5	J. & J.	102
St. Louis & Suburban...........	Com.	2,500,000	400	....	....	21½
" "	Bds. 1921.	1,400,000	100	6	F. & A.	90
Union Depo Railway...........	Com.	1,200,000	100	....	....	110
" " "	Bds. 1910.	1,000,000	100	6	A. & O.	104

The evidences of better business activity are present in the increase of new companies and new enterprises, the greater confidence in the trade and the larger buying orders. The times seem to have again reached us when manufacturers can make up a quantity of goods and dealers can place a stock on their shelves with confidence that they will receive for them a a price that will allow them at least a margin of profit.

PERSONAL.

Mr. Charles Wirt is now in Philadelphia where he expects to make his home for a time at least.

Mr. W. H. Whiteside is manager of the Chicago office of the Triumph Electric Co., of Cincinnati, Ohio.

Mr. R. B. Corey, formerly of the Electrical Supply and Construction Co., has opened an office at 714 Havemeyer Bld., New York, and will handle arc lamps, etc.

Mr. E. V. Cherry, president of the Standard Electrical Works, Cincinnati, has just returned from a sojourn of several weeks in Florida, where he went for his health.

Mr. W. A. Foote, president and general manager of the Jackson Light and Power Co., of Jackson, Mich., and also manager of the Battle Creek and Albion electric light companies, was a visitor at the offices of the ELECTRICAL INDUSTRIES last month.

Mr. W. B Tobey, general manager of the S. K. C. Specialty Co., of Pittsfield, Mass., was married on Wednesday, March 6th, and after the wedding set out for an extended trip. He has the best wishes of many friends in the electrical trade, with whom ELECTRICAL INDUSTRIES joins in extending congratulations.

NEW BOOKS.

The Telegraphists' Guide to the New Examinations in Technical Telegraphy. Including also an appendix dealing with dry and secondary cells, universal battery system, direct reading battery instrument, duplex, new system of morning testing, fast speed repeaters, etc. By James Bell. London: 1895. Electricity, 29 Ludgate Hill, London, E. C. Flexible covers; 100 pages; price, 1s. 6d.

This volume is a reprint of the series of articles which appeared in Electricity, London, under the title of Postal Telegraphs. The articles were appreciated and this volume gives them a permanent and convenient form. The subjects were treated in a practical manner, and numerous cuts are used to illustrate the texts. While they are prepared with a view to assisting students preparing for the examinations required before appointment in the government telegraph service, the contents are not confined entirely to the information required to pass such an examination. Questions are given which will greatly aid the student in acquiring a perfect knowledge of the subject.

TRADE PUBLICATIONS.

A catalogue recently issued by the Electric Heat Alarm Co., of Boston, presents systems of heat alarms as applied to buildings, shafting, grain elevators, etc. The information contained therein respecting thermostats and the best methods of protecting buildings, etc., will be found useful and valuble. The catalogue is made up in such a way as to be a handy ornament for the desk, and combines with others, a calendar feature, making it a handy reference.

The Commercial and Financial Chronicle has added to its list of publications a quarterly supplement devoted to street railway finances. The supplement contains about 100 pages of matter relating to street railways. It is issued to meet the growing demand for more reliable information regarding street railway securities and investments. The prominence this industry has attained, and the value of the investments, has made a reliable publication of this kind a necessity. From the high standing of the other financial publications of the W. B. Dana Company, we may expect in this an authority of merit. Besides the mass of information respecting street railways, it also contains several interesting editorials on timely subjects. Investors and bankers will find it a guide, and street railway men will find it a financial index of the industry.

The catalogue issued by the Triumph Electric Co., of Cincinnati, Ohio, has been gotten up with a great deal of care. The cover has been very neatly designed and executed. The contents have been attractively arranged and present the subject of electrical machinery in an effective manner. Two colors of ink are used on each page, which brings out the initial letters that are found at the beginning of each subject. The particular points in the manufacture and distribution of electrical machines are presented in catch lines in colored inks. The Triumph dynamos are illustrated by large wood cuts, and the details are shown by outline drawings. These cuts are accompanied by descriptions of their construction and operation. The catalogue also contains tables of dimensions of dynamos and motors.

The catalogue issued by the Helios Electric Company of Philadelphia, is especially attractive in many ways. The design of the embossed covers is neat and well executed. The arrangement of the contents is good and the subject has been presented in an effective manner. The Helios arc lamps for constant potential circuits are described and illustrated. The economy of arc lighting over incandescent lamps or gas is discussed. The various details of the Helios lamp are considered separately. The reflector plate is illustrated with diagrams showing the distribution of the light. A large number of ornamental lamps are shown on the pages of the catalogue. The designs are artistic and will correspond favorably with various styles of interior decoration. The lamps shown are for direct current, alternating current for both interior and exterior lighting and photo-engraving lamps.

BUSINESS NOTES.

GEORGE CUTTER has added an ingenious locking feature to his combination windlass and reports a growing trade in this device.

THE BEACON VACUUM PUMP & ELECTRIC COMPANY, Boston, has appointed Mr. L. W. Collins as its western representative with an office at 1105 Monadnock Block.

WM. HOOD, Chicago, has removed from 239 La Salle St. to 1105 Monadnock Block. Mr. Hood will, as soon as possible, occupy offices on the first floor of the building.

THE BROWNELL CO., Dayton, O., recently installed a 50 horsepower engine for running a 500-light Shawhan-Thresher dynamo in the Atlas Hotel of that city. The engine runs smoothly and is giving most excellent satisfaction, as is also the dynamo.

THE SHULTZ BELTING COMPANY, St. Louis, is having a good demand for its belts and other products, considering the universal depression. The company is surely getting its share of business, among its recent orders being some very desirable ones from all parts of the country.

C. E. WOODS & CO., have recently opened a very elegant suite of offices at 1614 Monadnock Block, Chicago. Designing electrical machines and apparatus, and the exploiting of electrical inventions and projects are the lines that have been taken up. Mr. Woods is well-known to a large circle of electrical men both by name and reputation. Apparatus that he has designed is in use in almost every section of the country.

THE AMERICAN ELECTRICAL MANUFACTURING COMPANY, St. Louis, is running at its full capacity in the manufacture of its incandescent lamps. The outlook is excellent and the company is making every improvement possible in the manufacture of its product. The capacity of its factory is 3,500 lamps daily. The growth of this company is very satisfactory when it is considered that in 1890 the output was but 150 lamps daily.

E. G. T. COLLES & CO., 260 So. Jefferson St., Chicago, are busy at their new quarters on a number of contracts for heaters and purifiers. The fire which destroyed their factory did not disable them long. Orders are being promptly filled, and their working force has been increased. The new factory which is to replace the one burned, will contain the most modern machinery for the manufacture of iron and steel apparatus.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., has its shops very busy at present in turning out some large machines recently contracted for. The company will soon be in the market with some new types of machines, which will be of interest to the trade. All the different departments in the works are being fitted out with long distance telephones so that connection can be made with any part of the United States where the long distance telephone reaches without loss of time.

R. B. COREY has established at 714 Havemeyer Bld., New York, headquarters for the sale of Bergmann arc lamps and Knight arc lamps made by the General Incandescent Arc Light Co. These lamps include lamps for every service, and in a great variety of styles. The Knight lamps are the invention of Mr. John C. Knight who is interested in the new combination. A stock of lamps is already open for inspection. A stock of carbons accompanies that of lamps and the trade will be supplied with either or both.

THE GLOBE ELECTRIC LIGHT CO., Boston, Mass., recently closed negotiations for a large four-story building at the corner of Clifton and Shirley Sts. The building is 150 by 65 feet witn a two-story L which contains engine and boiler rooms, pattern shop, etc. The property was secured by Mr. Edward F. Draper, the general manager of the company. The buildings are particularly well adapted for the manufacture of incandescent lamps. It is free from vibrations, well lighted and ventilated. It is well constructed, and is considered one of the best manufacturing properties in New England. The lot contains over an acre of ground and has an excellent artesian well.

THE LOMBARD WATER WHEEL GOVERNOR CO., 61 Hampshire St., Boston, Mass., has furnished one of the Lombard governor regulating wheels to the Public Works Co. of Bangor, Me., for the plant at Vesey, Me. It was the only governor that could be found to do the work and it has given perfect satisfaction for four months. There is also one of the type A governors handling the wheels of Hollingsworth & Whitney at Waterbury, which is also giving satisfaction.

THE HORNBERGER ELECTRIC CO., Elkhart, Ind., is now under the entire control of Mr. John C. Boss, who, although a large stockholder, has recently made further purchases of stock. Mr. Boss is giving his entire attention to the affairs of the company, and the business which has grown rapidly since the company was first organized as the Electric Construction Co., will be greatly extended. The products of the company already occupy an important place on the market where they will soon be more widely known.

THE ELECTRIC POWER STORAGE COMPANY, New York, recently closed a contract through its western representative, Wm. Hood, with H. H. Porter, president of the Chicago & Eastern Illinois railway, for 120 350-ampere hour storage batteries, which will be used for lighting his summer residence at Lake Geneva, Wis. The company is fortunate in having secured Mr. Hood as its western agent, an arrangement which was but recently made. Mr. Hood's extended experience in the sale of storage batteries will, without doubt, make the business a great success in the west.

THE CUMMINGS & ENGELMAN CONDUIT CO., Detroit, Mich., reports that its works are busy in the manufacture of conduit to fill contracts. Among the orders recently placed on the books is a large one from Niagara Falls which calls for four and one half inch tube containing six ducts for the bare conductors that will be used for the distribution of current at 2,000 volts. This conduit is to be used for the local distribution of current at that point, and is considered a most valuable and important contract. This conduit has been illustrated and described in previous issues of this journal.

MR. TIMOTHY W. SPRAGUE, Boston and New York, has opened offices, and offers his services as consulting engineer, making a specialty of electrical mining apparatus, power and transmission systems. Mr. Sprague was five years with the power and mining departments of the Thomson-Houston and general electric companies, and was also for a time with the Westinghouse, Church, Kerr & Co. The amount of work being done in this branch seems to warrant an engineer giving his entire attention to it, and although a specialty is made of mining plants Mr. Sprague will also undertake engineering work of other kinds.

METROPOLITAN ELECTRIC COMPANY has been appointed agent for the Solar arc lamp, a lamp of unusual merit for incandescent circuits. Its feed mechanism is so simple and adjustable that it has been found to be a most thoroughly economical and practical lamp. It is simple in construction, has a positive action of feed, no springs or dash pot, no see-sawing. The lamp is manufactured plain or in various styles of ornamentation to meet the requirements. Samples are being exhibited at the ware rooms of the Metropolitan Electric Company, 186 and 188 Fifth avenue, Chicago, where they carry a stock for immediate shipment. Prices are made to suit the times. The new carbon open-circuit battery, recently placed on the market, is in good demand.

THE ELECTRIC APPLIANCE COMPANY, 242 Madison St., Chicago, is entering upon an active campaign for lamp business with the original Packard lamp with platinum leading in wires as it was made before the time of the incandescent lamp litigation. They are making some very strong claims regarding a rather remarkable improvement which has recently been achieved in the manufacture of the Packard lamp, by means of which the lamp increases in candle power and efficiency during its life. The importance of such an improvement cannot be over-estimated, and, if it is true to any marked extent, it will readily be seen that the comparative first cost of the lamp drops almost out of consideration, as a small increase in candle power and efficiency during its life will result in a saving of several times the original cost of the lamp. The company has issued recently, a circular of the improved Hunning telephone and American telephone switch board.

THE GOULDS MFG. CO. has just begun the erection of the new addition to its extensive works at Seneca Falls, N. Y. The construction of this building is necessitated by their steadily increasing business in triplex power pumps. The building will be a modern structure of the slow burning type. Its length is 86 feet and width 35 feet. The frame work, beams, columns and roof truss will be of steel. The building will be two stories in height with basement for storage of castings. The main room for heavy machines and erecting purposes will be 22 feet high and served by an electric bridge crane of 10 tons capacity. The gallery will divide one side into two stories for lighter machine tools. The walls will be of brick, while the skylight and upper windows will be glazed with ribbed glass. The entire main floor is designed to stand a uniform strain of 400 lbs. to the square foot, although a limited area is capable of bearing 600 lbs. to the square foot. It is expected that the building will be completed about June 1st.

THE WALKER MANUFACTURING CO., Cleveland, O., has taken the following contracts between March 1st and March 22d, 1895: Messrs. Burhorn & Granger, No. 136 Liberty St., New York, N. Y., two 25 kilowatt D. C. lighting generators; F. E. Snow, receiver Adrian City Electric Belt Ry. Co., Adrian, Mich., one 60 kilowatt belted generator, three 25 horse-power single car equipments; Union Depot Railroad Co., St. Louis, Mo., 41 double car equipments, 82-30 horse power steel motors; Pittsburgh Traction Co., Pittsburgh, Pa., one double car equipment, three 30 horse-power steel motors; Pittsburgh, Crafton & Mansfield Passenger Ry. Co., Pittsburgh, Pa., one double car equipment, two 50 horse-power steel motors; Federal Street & Pleasant Valley Pass. Ry. Co., Pittsburgh, Pa., two double car equipments, four 30 horse-power steel motors; Suburban Rapid Transit Street Ry. Co., Pittsburgh, Pa., one double car equipment, two 35 horse-power steel motors; Schuylkill Electric Railway Co., Pottsville, Pa., four double car equipments, eight 25 horse-power steel motors; Chicago City Railway Co., Chicago, Ill., 49 double car equipments, 98 25 horse-power steel motors.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, reports a very satisfactory business. In order to take care of the growing demand for its product it is now increasing its capacity by the addition of a 200 horse-power boiler, a 175 horse-power engine and a 90 K. W. alternator. This progressive company is adding all the improvements in the way of making its goods meet the requirements of the trade. The coil-filament, high-efficiency lamp is meeting with great success as it is very economical and maintains a very uniform candle-power during its life. The company now claims to have next to the largest capacity of any lamp company in the country. When the additions to its factory are completed it will have a capacity of from 10,000 to 12,000 lamps per day. The outlook for future business is reported very bright.

THE WALLACE ELECTRIC COMPANY, Chicago, will on May 1 move to 305 Dearborn St., one door north of its present location. In the new location the company will occupy floor space double that at the old location and besides will have a larger store room, better shipping facilities and in every way more desirable quarters. This change has been necessitated by the growth of the business and the necessity for better accommodations. At present the company is very busy in its various departments, its agencies being among the most desirable, it having recently secured the western agency for the Boston incandescent lamp, R. B. Corey's arc lamps for all circuits, and the electric light and power controllers made by the Electric Selector & Signal Company. The company also, through Messrs. Wallace & Hine, has the western agency for the Stanley Electric Manufacturing Company, and the outlook for the sale of this apparatus is most promising throughout the west. Its management is to be congratulated upon the excellent success secured.

HOADLEY BROS., the well-known engineers located in the Old Colony Bldg., Chicago, have just purchased what is conceded to be one of the most important patents issued for use in large central power stations. It is known as the American system of steam distribution and patented by Mr. F. Sargent, formerly engineer of the World's Fair. This system is now in use in all the large electric stations recently built in Chicago, among which are the Chicago City Railway, Metropolitan Elevated, Garden City Railway Plant, Chicago Edison Company's new Harrison Street Station, New Stock Exchange Bldg., new Chicago Library, North Chicago Electric Railway Power Station, West Chicago Street Railway power plant, and has been designed for use in the new station of the Cicero & Proviso Street Railway. It is also stated that the Edison Illuminating Co., of New York City, will use this piping system throughout its new stations. Inasmuch as this system is almost indispensable in large power plants, the importance of the right secured by Hoadley Bros. is apparent, and the consideration is stated to be very large.

WOVEN WIRE BRUSH.

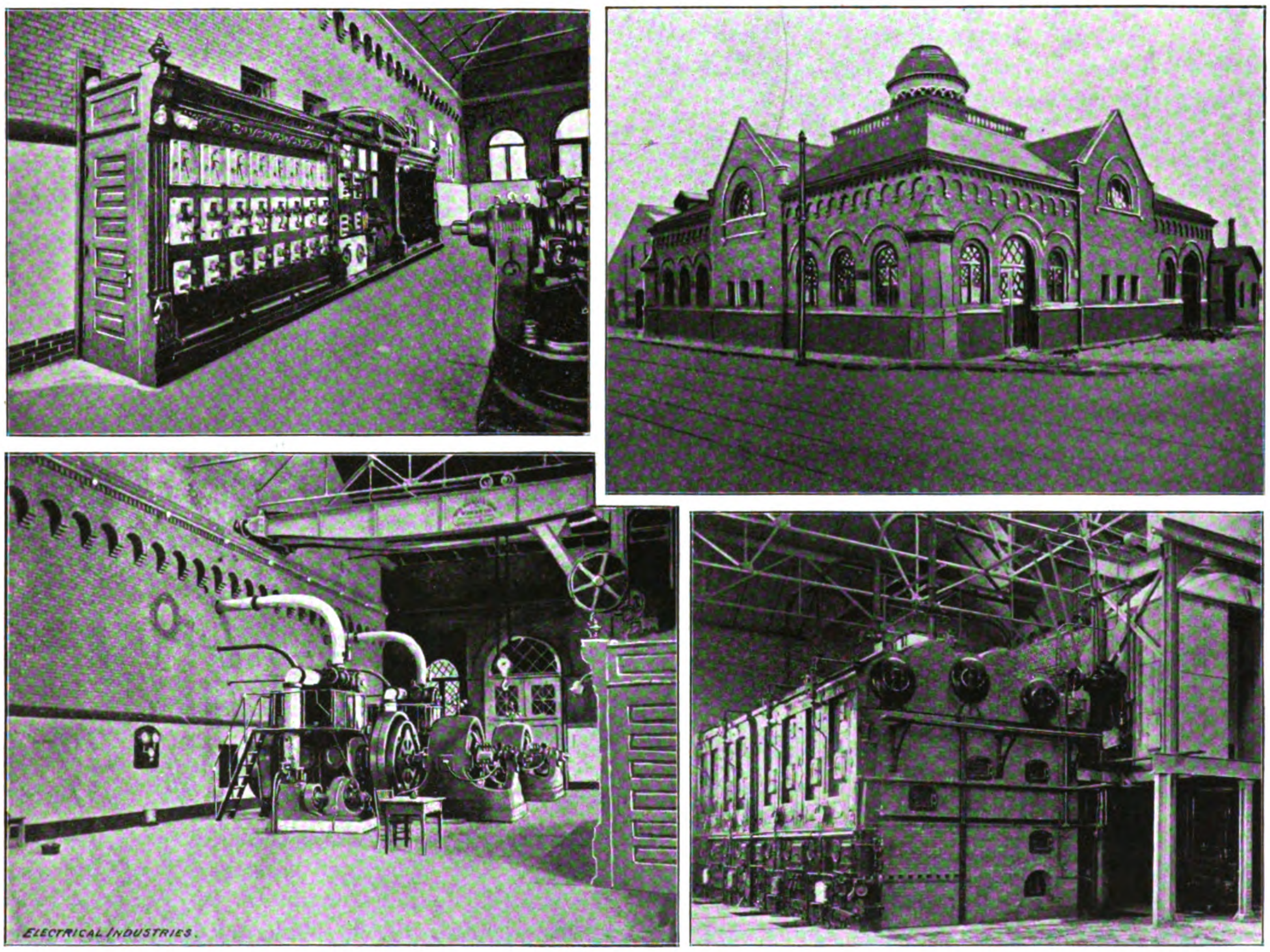
The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. May, 1895. NEW YORK. No. 5.

The New Power House of the Columbus Central Railway Co.

The construction of a power house for an electric railway involves an experience and skill able to provide most intelligently not only for present but for future demands. The design of the building, the selection of the equipment and its arrangement require that the present knowledge on the various subjects shall be wisely used and also that future practice shall be in a measure anticipated and provided for. Thus in each new power house constructed we look for those features that will show the improvement in former and suggestions of what will be the future practice. In the power station and equipment of the Columbus Central Railway Co., of Columbus, Ohio, which is illustrated in the accompanying engravings, a number of novel features appear.

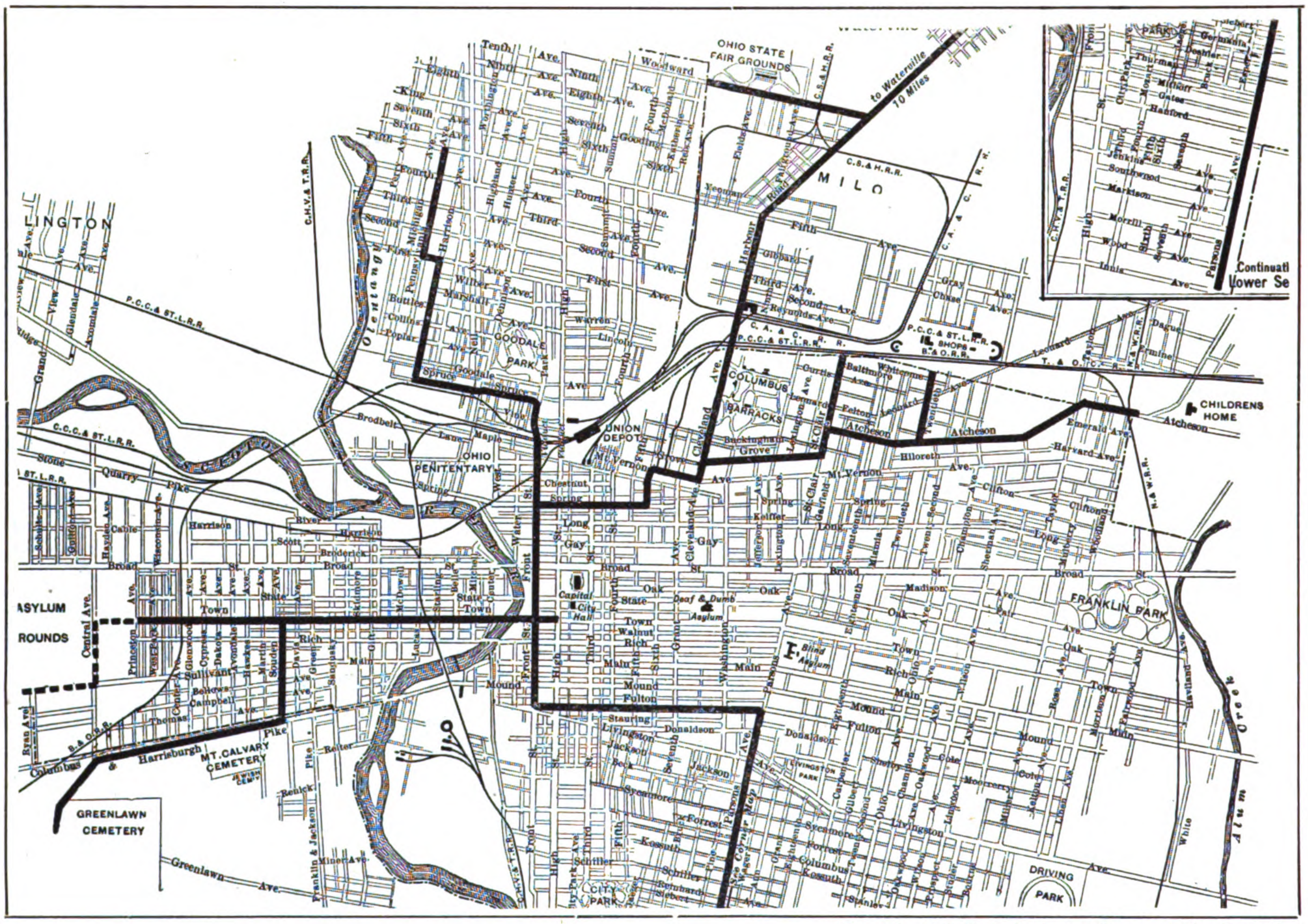


FIGS. 1, 2, 3 AND 4.—THE NEW POWER HOUSE OF THE COLUMBUS CENTRAL RAILWAY COMPANY.

The exterior of the building has been so planned that there is no suggestion of shop, factory or power plant. Its style gives it the appearance of a public building and possesses a certain dignity appropriate to such a building. It is ornamental in appearance and possesses none of the features which usually make such buildings objectionable in a good residential district. The tall smoke stack is conspicuous by its absence. There is a stack, however, that has been cleverly concealed in the design of the building. Up through the ornamental dome that surmounts the building an eight foot stack rises in such a manner that no part is visible from without. This plan has not in any way been detrimental to the proper arrangement of the power equipment.

The building is built of brick with stone trimmings. The floors are of concrete and the interior of the walls is finished in white and cream colored glazed brick. The roof is of Spanish tile supported on iron trusses. The building is therefore as near fireproof as it is possible to build. In size it is one hundred by one hundred feet. The stack which reaches the highest point of the dome is seventy feet in height. The ceiling is high and the interior is light and well ventilated.

The engines and generators of the power plant are direct connected Westinghouse compound engine and Westinghouse multipolar generators. They are both mounted on one bed plate and are connected by a universal flexible and insulated coupling, The details of this combination are shown in the outline cuts. The generators are each of 200 kilowatts capacity, compound wound and multipolar as shown. The general form of the generators is the same as that of nearly all the Westinghouse generators and motors and which is recognized at once by all familiar with electric power apparatus. The solid character of the yoke and pole pieces is shown in the cross section cut. The armature is entirely surrounded by the iron magnets. The space between the poles is only sufficient for the accommodation of the field coils.



[From Street Railway Spplement Com. and Fin. Chronicle.]

FIG. 5.—COLUMBUS CENTRAL RAILWAY—MAP OF LINE.

The maximum efficiency is by this method secured in the fields of the machine. The field coils are wound on spools which slip over and are fastened to the pole pieces. The bearing supports are cast on the frame of the machine, a method that gives great rigidity and strength. The bearings are self-oiling and aligning, and require but little attention. The armature, one of the most important parts of the generator, has received a proportionate amount of attention. The heavy copper conductors that form the windings are well insulated and are placed in insulated forms that fit the slots in the armature core. The whole is firmly secured and so accurately balanced that the minimum amount of air space is left between the armature and pole pieces.

The brush holders are of an improved pattern and four are mounted on each rod. The conductors from the brush holders are carried to the side of the machine and then pass beneath the floor and by means of buried conductors to the back of the switchboard. A cluster of incandescent lamps on an ornamental fixture attached to the top of the generator gives a neat finish to the machine. An insulated base intervenes between the frame of machine and bed plate. The connection to the universal coupling is also insulated.

The engines as stated are of the Westinghouse compound type, run non-condensing. The cylinders are eighteen and thirty inches in diameter respectively, with a stroke of sixteen inches. A section of this engine is shown on Fig. 2. The single acting and the compound principles are both shown. The impulse is given to the pistons in but one direction. While in the double acting engine the pressure is first on one side of the piston and then on the other; the two cylinders in this engine perform the service. The steam being used twice, first in one cylinder and then in the other must effect good economy. The Westinghouse Machine Co., the manufacturers of this engine, have been strong advocates of the single acting engine, and have shown the success of the principle in the thousands of engines in successful operation.

The engine is enclosed and the crank shaft runs in oil, a feature that is conducive to great durability and efficiency. The steam valve is actuated by a single eccentric controlled by a shaft governor. The parts of the governor, with the exception of the eccentric, are enclosed in an oil tight case. This case is filled with oil when the engine is set up and needs no attention for an indefinite period. The different parts of the engine are reached by a foot board at a sufficient elevation to make all parts easily accessible. Iron steps and railing lead up to the foot boards. It is arranged to form a neat gallery about the engine. The steam pipes pass from the boiler room through the wall and instead of short elbows bends of large radius are made to the engine. The friction of the steam connections is reduced as much as possible.

The switchboard is conveniently located at the center of the side of the engine room. It was built by the Freeman Mfg. Co., of Columbus, and is a very handsome board. The face of the board is slate of an extra thickness. The front is marbleized and the back shellaced. The board proper is enclosed in a heavy frame of polished mohagany. The top and columns are handsomely carved, and the board as a whole is one of the finest to be found. It is thirty-one feet long, ten and one-half feet high, and is placed three and one-half feet from the wall. It contains four generator panels and sixteen feeder panels, provision being made for future extensions of the plant.

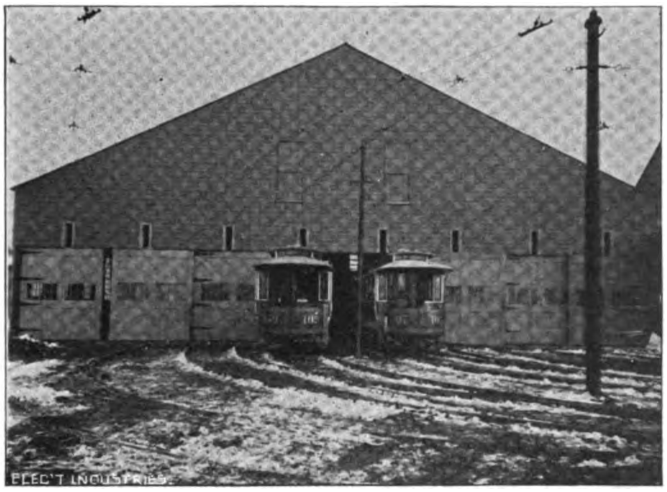
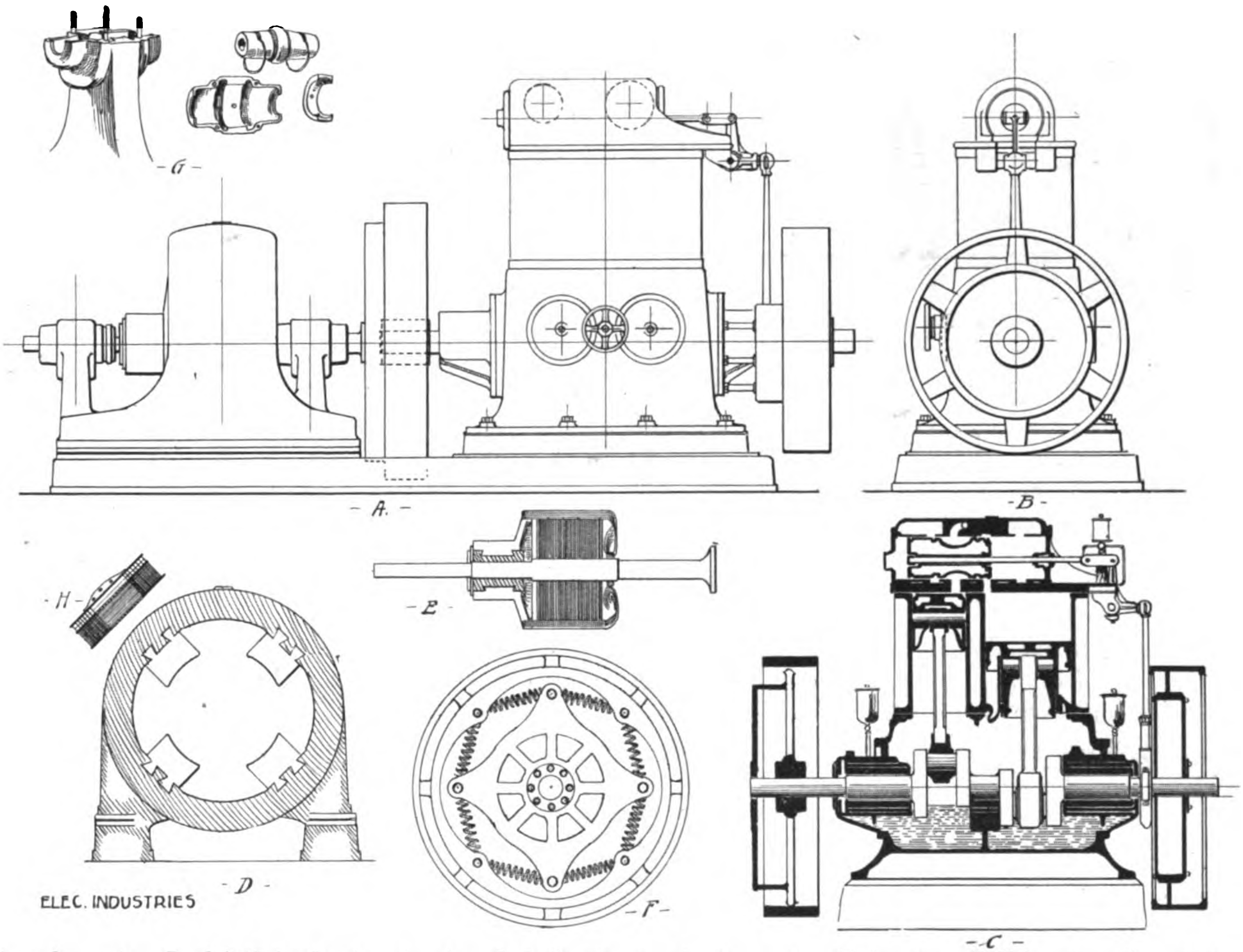


FIG. 6.—COLUMBUS CENTRAL RAILWAY—CAR BARNS.



A—Engine and generator. *B* and *C*—End and section of engine. *D*—Section through poles of generator. *E*—Armature. *F*—Universal coupling. *G*—Bearings of generator. *H*—Field coil of generator.

FIG. 7.—THE POWER HOUSE OF THE COLUMBUS CENTRAL RAILWAY.

The conductors from the generators come up back of the board from a pit which is easily accessible by raising the wooden gratings that form the floor. The instruments are all made for connection back of the board. The bus bars and equalizer bar are constructed of round copper rods supported in porcelain insulators through which they pass. Connection is made to these rods by clamp connectors that pass clear around the rod.

The generator panels are placed at the center of the board and contain ammeters, voltmeters, test instruments, rheostats, etc. The automatic circuit breakers of the feeder panels are connected to an alarm that sounds and continues to sound while it remains open. This arrangement has been found advantageous as the engineer may be called to boiler room or some other part of the building. The alarm can be heard anywhere about the building.

Traveling on a track on the engine room walls above the machinery of the room is a traveling crane of sufficient capacity to lift any piece of machinery in the plant. It carries a platform from which an operator by means of the levers placed there is able to control all movements of the crane. It was built for this power house by the Phoenix Iron Works Co. of Cleveland, Ohio. The value of the crane in placing the machinery and as a means always at hand for replacing parts of machines cannot be easily estimated. It runs the entire length of the room.

The steam generating apparatus consists of four Stirling boilers of 200 horse-power each. There is room for double this equipment when more power is required than the present plant affords. These boilers are of the well known Stirling type. They were erected on solid foundations of brick and concrete, and were built without the use of cast iron or cast steel, in their construction, which, together with the manner of the construction, make them one of the safest of boilers. In construction, the boiler consists of a large drum placed back of the furnace from which the water tubes rise to the three drums placed above. The position of the tubes is noteworthy, for by it the tubes are kept free from all impurities which are precipitated by the heat into the mud drum placed back of the furnace grates. Where the tubes enter the drums they are so secured as not to be effected by expansion and contraction and the longitudinal expansion will not injure them owing to their peculiar shape. The boilers have a large draught area; the vertical position of the tubes and the arrangement of the brick baffle plates in the large tube chamber insures a good draught at all times. The special construction of the fire brick arch over the furnace with the wide draught area causes the gases and air to thoroughly mingle so that a perfect combustion is insured.

Thorough circulation takes place in the boiler due to the fact that each water tube being expanded directly into the circulation drums has a separate outlet equal to its own area. Although these boilers, owning to their peculiar construction, require little cleaning, abundant and ample openings are provided so that easy access can be had to any and all parts of the boiler.

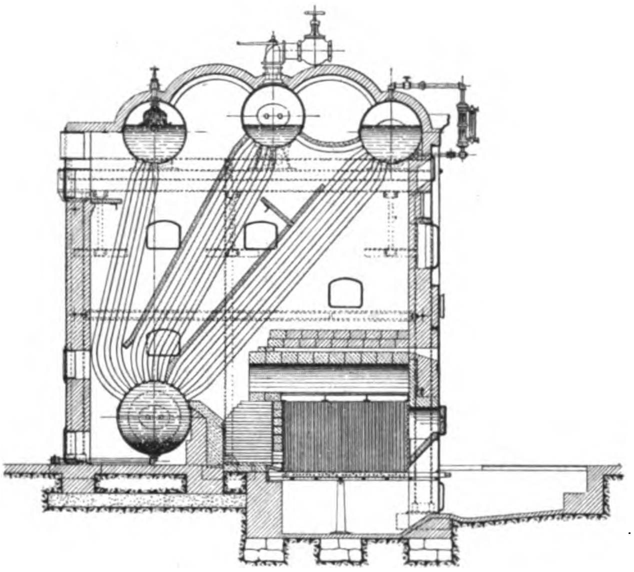


FIG. 8.—COLUMBUS CENTRAL RAILWAY—THE STERLING BOILER.

The gases of combustion pass through an improved form of fuel economizer before reaching the stack and cooled to such an extent that a mechanical draft system was necessary with a short stack. The system of Westinghouse, Church, Kerr & Co. is used. There are two slow running exhaust fans made by the Buffalo Forge Co. at the base of stack operated by small direct connected engines. National feet water heaters are also used and the exhaust steam escapes by way of the stack where the heat reduces it to an almost invisable vapor. Stokers are used for feeding the furnaces and the entire equipment has been arranged so as to require the least amount of manual labor and attention.

The power house and equipment have been carefully planned and skillfully constructed. The apparatus used is the most improved of the several kinds. But one-half of the power equipment is as yet installed, being 400 kilowatts capacity. The demands of the road it is expected will require the full equipment or 800 kilowatts capacity to be installed within a year. This, however, will allow them extra machines so that in case of accident to one there will be another ready to put in. The engineers in charge of the construction were: Messrs. Barry & McTighe of New York.

Factory Practice in the Design and Construction of Dynamos—I.

BY C. E. WOODS.

This subject, while not new, inasmuch as it has been treated by many able minds, is still as full of interest to the general class of electricians as ever, if not more so. The effort of most writers, however, has been strictly for the benefit of the experienced engineer, rather than for the artisan and public at large, and in the articles which the writer has undertaken to produce, an effort will be made to shape them expressly for the benefit of the latter class of people, and especially for those who operate electrical machinery. In the details presented, if anything is not thoroughly understood, the writer will be pleased to answer any inquiries which may be made thereon throught the medium of Electrical Industries. There has always been a sort of chasm between the operators of dynamo electric machinery and its designers, and the actual scope of the following articles will be to bridge that chasm as well as possible, and form a bond of understanding which will be both mutual and lasting. Without a gradual leading up to the main points in dynamo design, an understanding of these points would never be reached, and in order to eliminate any confusion, we will take one dynamo of one particular type and remain with it until we have studied every detail and then take up other types in order.

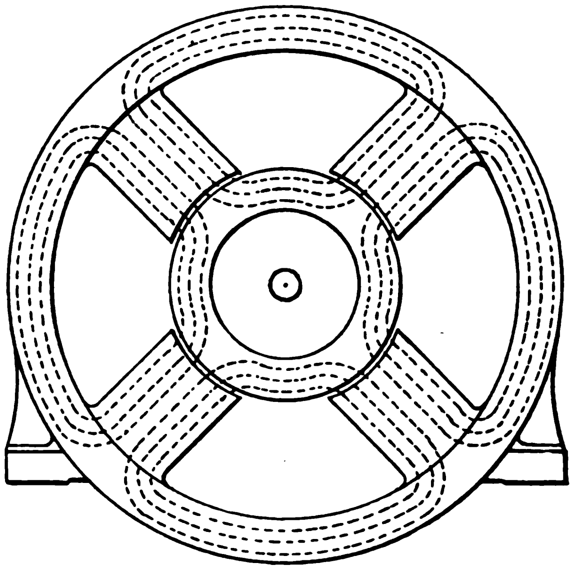


FIG I

Probably the most interesting type that we can commence with will be a multipolar dynamo, with four poles. In explanation, the multipolar dynamo is a dynamo having more than one pair of poles, constructed in a circle equally distant apart, around an armature, the poles having one common outside ring to which they are all fastened, as illustrated in Fig. 1. The proportions of this cut will be set forth later on. The advantages obtained in this form of dynamo are many, and of great importance, which will be clearly illustrated in the final summary of this series of articles. We should first consider in preparing the design of a dynamo, its fundamental principles, and the first question that naturally comes to the mind of a layman is, by what and how is the current generated? Briefly, the reply would be, by a conductor passing through lines of force, or cutting lines of force, as ordinarily expressed. Of course the next inquiry will be, what is a *conductor*, and what are *lines of force*.

First.—A conductor is a substance through which electricity will flow. Metals are the best conductors—silver being the best of all, and copper the next. The difference of price in these two metals, of course compels the use of copper in the construction of electric appliances. *Lines of force* is simply a name given to that force or power which reaches out from a magnet and attracts other pieces of iron to itself, as can be observed with any ordinary horse shoe magnet. These lines can neither be seen nor felt, except as they perform labor. They are in the " mind's eye " of an electrician, and are thought of as a bunch of hairs on a brush, situated at the end of a piece of iron, horse shoe magnet, or pole projection, which has an open space between the north and the south pole. Fig. 2 simply illustrates the idea of these lines, one end being a north pole and the other end being a south pole, with an air space, the length of the magnet, between the poles.

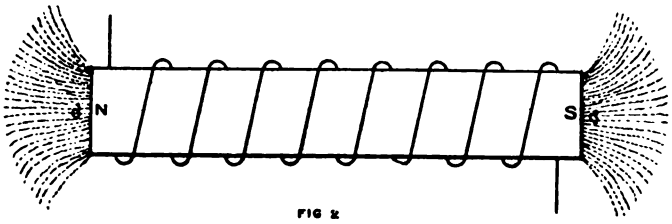


FIG 2

In an ordinary horse shoe magnet, which is bent around in a semi-circle, the two ends are adjacent to one another, and nearly every one is familiar with their operation in the attraction of pieces of iron to themselves. If the piece of iron is on the two poles, a much stronger attraction is made than would be with an attachment of the piece of iron to only one limb of the magnet. Now, if we take a loop of wire and pass it rapidly through these invisible hairs or lines of force, a current of electricity will be generated in the wire (Fig. 3), which can be collected from the two ends, c c. The exact formula as to why a current will be generated will be considered a little further on. We have first to understand more about these lines of force. Cast iron will carry as a maximum with sufficient exciting current supplied—that is, the current flowing through the coil of wire around it—50,000 lines, or invisible hairs, per square inch. The amount of current required to do this depends upon the condition of what is considered the magnetic circuit, or the line of travel of these lines of force, which is the length of iron and number of joints of air gaps.

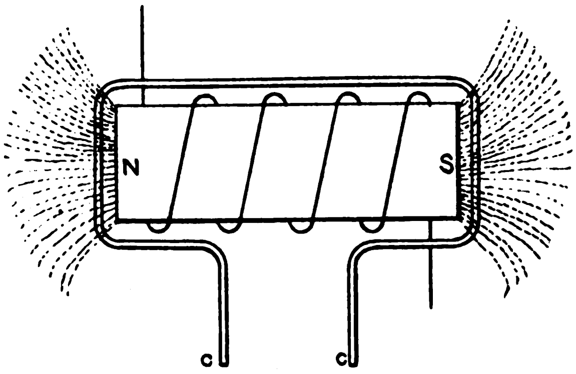


FIG 3

In Fig. 4, four poles will be observed projecting inward through which a very few lines will flow (only one being shown), when these projections are surrounded by a coil of wire through which a current is passing. The reason but few lines can flow in this case is because of the great distance of air space between the poles, air being the greatest resistance or obstruction known to the flow of magnetism which is the same thing as lines of force. Referring to Fig. 1, it will be seen that an iron disc, or armature, has been introduced, which greatly lessens the air gap, thereby letting many more lines of force flow with the same amount of existing current flowing through the coils. There are, however, two air gaps for one magnetic circuit, of which there are four indicated by the dotted lines. The air gap or space in a dynamo is occupied by wire, and a certain amount of clearance, which permits this armature or disc to rotate. On this disc are placed, in several different ways (which will be brought out later on), loops of wire, and as power is applied to the shaft on which this disc is suspended, this wire is continually being driven through the lines of force which traverse the polar projections, and the core of the disc, which forms a complete circuit, as shown by the dotted line in Fig. 1.

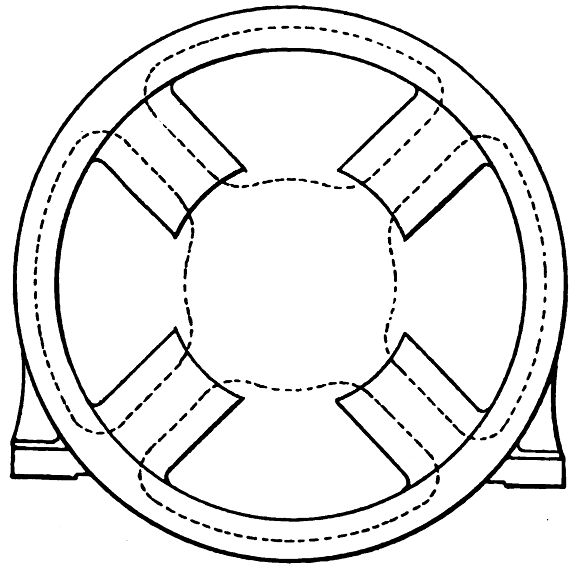


FIG 4.

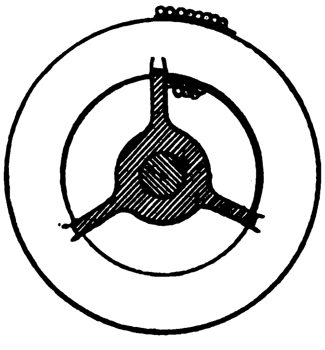


FIG 5.

This, then, is the principle upon which dynamos generate a current. Having outlined this principle, let us next consider the dynamo that we really want build, and lay out its electric proportions. We will start in with first a 15 kilowatt, multipolar generator, four poles, having what is termed a gramme ring armature to run at a speed of 1,000 revolutions, and give a voltage of 125 volts. The first thing we naturally have to consider is, how many amperes does a machine of this kind require. Now, a kilowatt signifies 1,000 watts, and 15 kilowatts would mean as a result, 15,000 watts. Watts are a product derived from a multiplication of the volts and amperes. Knowing one factor, which is the voltage of 125 volts, we have only to divide 15,000 watts by 125, which gives us 120 amperes. So here we have the first requisition upon which the machine is to be designed, viz.: 125 volts, 120 amperes, 1,000 revolutions, four poles, with a gramme ring armature.

In explanation, it should be said that a gramme ring armature is an armature so constructed that the wire is wound around a ring formed of iron discs, which are usually punched out of sheet iron, and when put together are insulated from one another by paper, or a similar material. This iron ring is mounted on a spider or metal frame, which clamps them tightly together, leaving an opening in the center, through which the coils of the winding are passed around and around the ring. The spider is fastened on the shaft and supports the armature. Fig. 5 shows a cross section of a ring armature, with wires on the upper and lower sides. How these wires are related to each other will be demonstrated later. In Figs. 1 and 4, the path of flow for the lines of force is indicated by dotted lines. Since these extend from all polar projections in two different directions, the cross section of the ring in the armature and also the ring or yoke that connects the poles together on the outside, carrying one half as many lines, has only to be one-half the cross section of the poles themselves.

As wrought iron will carry 40 per cent. more lines of force than cast iron, and as the armature core is made up from sheets of wrought iron, the actual cross section of the armature core is in proportion to this difference in what is commonly termed the permeability of the different irons, consequently it will be somewhat smaller than exactly one half the cross section of the polar projections. Permeability simply means conductibility for the lines of magnetic force, and it is well to observe here that permeability decreases as magnetism increases. When a piece of iron has been magnetized up to a certain point, its permeability becomes less for any further magnetism; or in other words, the iron will have reached magnetic saturation. But as this is purely a technical consideration, beyond the explanation given I will not dwell upon it at this stage of our work. The next thing we have to consider is the size of wire that must be used for winding our armature.

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*As an expert in the designing and construction of electrical apparatus of all kinds, Mr. C. E. Woods, the author of this series of articles, is well known to the electrical fraternity and as a writer on both technical and popular subjects his name is already familiar to a large class of readers. Mr. Woods was born in Pittsfield, Mass., of that same New England stock that has become prominent in so many fields of industry. Having a natural aptitude for mechanics his attention was early turned in that direction. Electricity was a favorite study and as its commercial advantages became known he took up practical electrical work in conjunction with steam engineering. For the past fifteen years he has made that his profession. A wide knowledge of the various branches of the industry has been acquired by a close and persevering study. In the operation of central stations, in the construction and arrangement of the plant, the use of the various electrical appliances and in the construction and testing of machines the practical side of the subject was thoroughly mastered. His work in the designing and construction of electrical apparatus which is now made by several well-known companies gives promise of a lasting reputation in the success of the lines of direct and alternating current lighting and power machinery and accessories, which are now in use in this country. Mr. Woods has established this year independent offices and is at work on a number of important problems which have received the attention of advanced engineers and which have every prospect of fulfillment.

C. E. WOODS.

There was recently incorporated at Spring field, Ill., The Interocean Electric Railway Co., which proposes an electric railroad from New York to Chicago and possibly to San Francisco. The company has a capital stock of $200,000,000, shares $100 each. The road is to be elevated and carry freight. The principal offices of the company are in Chicago.

The Alternating Current; Its Generation and Distribution.—VI.

BY PROF. GEO. D. SHEPARDSON.

The principles of the magneto generator, and a diagrammatic sketch showing its construction, were brought out in the fourth paper in Electrical Industries of January. Fig. 16 shows outside and inside views of a common form of magneto used for telephonic signalling or for testing. The crank at the side of the case is connected with a toothed wheel inside the case which drives a small pinion on the right end of the armature shaft. The armature thus makes several revolutions for each one of the handle. One end of the armature circuit is connected through an insulated pin in the center of the shaft at the left end, to one of the binding posts at the side or top of the wooden case. The other end of the armature circuit is connected to the frame of the magneto, from which a wire runs through the magnet coils on the cover and thence to the other terminal. The cores of the electro magnet are connected with a bar of steel permanently magnetized. A small strip of iron to which the bell hammer is attached, is hung so as to connect the lower pole of the permanent magnet with the iron core of either side of the electro magnet This strip is attracted to one core and repelled from the other one according to the direction of the current. It therefore moves from one side to the other each time the direction of the current changes. Since the magneto gives an alternating current, the vibrator and the hammer of the bells will move to and fro and ring the bells. Magnetos of this type are often provided with a leather strap handle for convenience in carrying, and may also be provided with

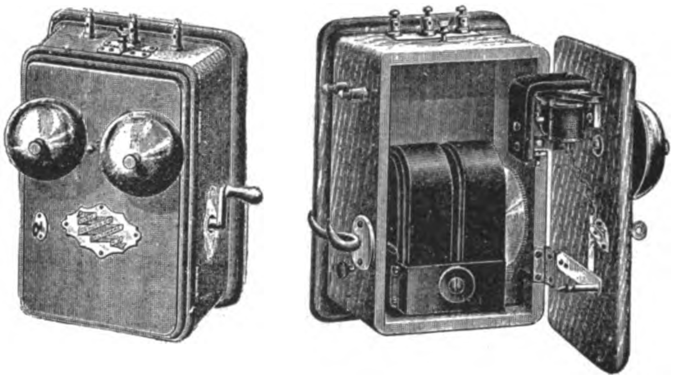


FIG. 16.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

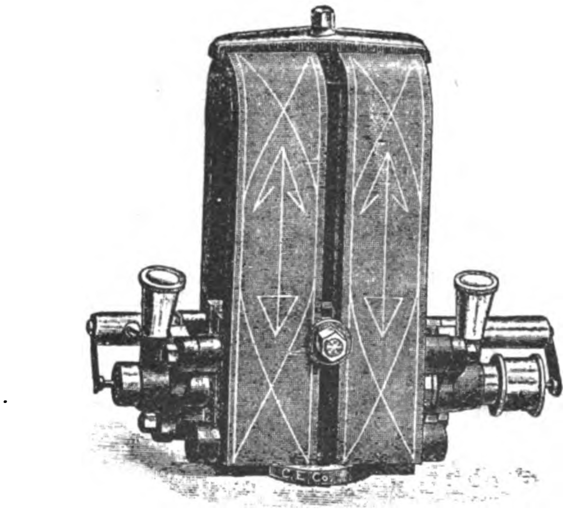


FIG. 17.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

everal yards of flexible cable for ease in making temporary connections for testing. In some magnetos, the bells are inside of the case so as to be out of the way.

A larger size of magneto intended for use in telephone exchanges or factories is shown in Fig. 17. These do not usually have a cover. They are run by belts and are provided with oil cups of considerable capacity so that they may be run continuously with little attention.

It is desirable to consider some reasons why the magneto generator is not made in larger sizes for electric lighting and power purposes. The two principal reasons are the difficulty of obtaining a sufficiently large and strong magnetic field with permanent steel magnets, and the difficulty in making an armature mechanically strong enough to rotate at the speed required for ordinary uses of alternating currents.

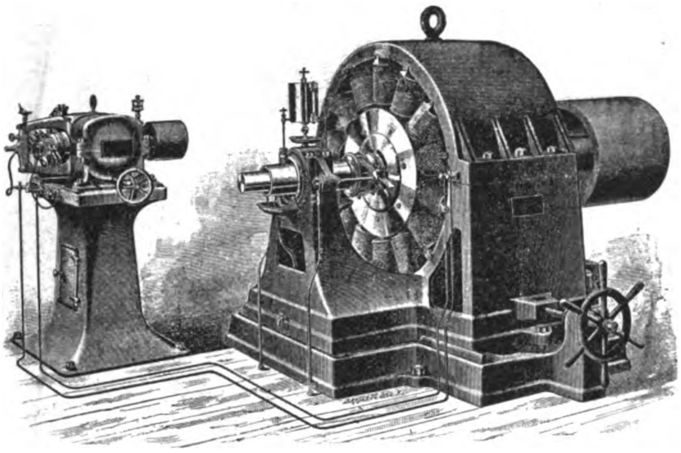


FIG. 18.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

The first difficulty might be overcome by using electro-magnets, since a much stronger magnetic field may be obtained from them than from permanent magnets. The first dynamos of considerable size were used for public lighting, one of the earliest being the "Alliance" machine at the lighthouse of South Foreland, England, in 1859. The magnetic field of this machine was supplied by 40 horseshoe steel magnets.

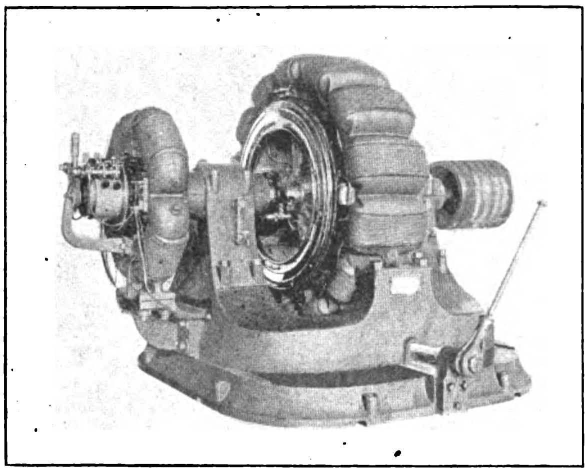


FIG. 19.—THE ALTERNATING CURRENT; ITS GENERATION AND DISTRIBUTION.

A fatal objection to the use of permanent magnets in large machines intended for electric lighting is that the strength of the magnets cannot easily be adjusted to suit varying conditions. Permanent magnets also become weaker with age and with use, so that they have been abandoned except for small machines. So much better results are obtained with electro magnets, that none of the modern machines of large size use permanent magnets. The current for magnetizing the fields of most alternating generators, or "alternators," is obtained from a small continuous current dynamo or "exciter" which may be an entirely separate machine or which may be built as part of the same machine. Separate exciters are more commonly used. Fig. 18 shows one of the earliest alternators used in America, and illustrates the method of exciting the field magnets of the alternator by current from a separate exciter. Fig. 19 shows a more recent machine by another maker, having the field magnets of the exciter and alternator built upon the same frame and having both armatures upon the same shaft.

Obituary.

GEORGE M. PHELPS.

Mr. George M. Phelps, whose death occurred in Brooklyn, N. Y., on April 11, was a well-known and highly esteemed member of the electrical fraternity. His business life was spent in connection with those interests, first with the manufacturing interests and later with the electrical press. He inherited much of his aptitude for electrical mechanism and love for perfect workmanship from his father whose name is inseparably connected with a number of important inventions, among which are the Phelps ticker, Phelps telephone, etc., acquired by the Western Union Co.

Mr. Phelps was born in Albany, N. Y., in 1843, where he received his early education and training. In 1861 he became connected with the works of the American Telegraph Co., of which his father was superintendent. From 1871 to 1879 he was associated with his father in the conduct of the Western Union factory in New York. For several years up to 1885 Mr. Phelps, was superintendent of the New York factory of the Western Electric Co. He then united with Mr. F. L. Pope in conducting "The Electrician and Electrical Engineer," a monthly electrical paper. When the paper was incorporated and published as "The Electrical Engineer" a weekly, he was elected president, a position he held up to the time of his death.

He had a pleasant and kind disposition that was manifest in all his dealings, a social nature that found special enjoyment in the clubs and institutions with which he was connected. He was a charter member of the American Institute of Electrical Engineers and held the post of treasurer from 1887. The institute received a great deal of his attention and assistance. He was a member of the Hamilton Club of Brooklyn, and the Reform Club of New York. The large circle of friends that knew him in social gatherings, in business and during the useful life which he lived know him now but to remember him as a genial and pleasant acquaintance, a firm and loyal friend, and to miss the generous and thoughtful nature which to many has been of untold assistance. His illness was of short duration and his death occurred before more than a few realized the serious nature of the attack.

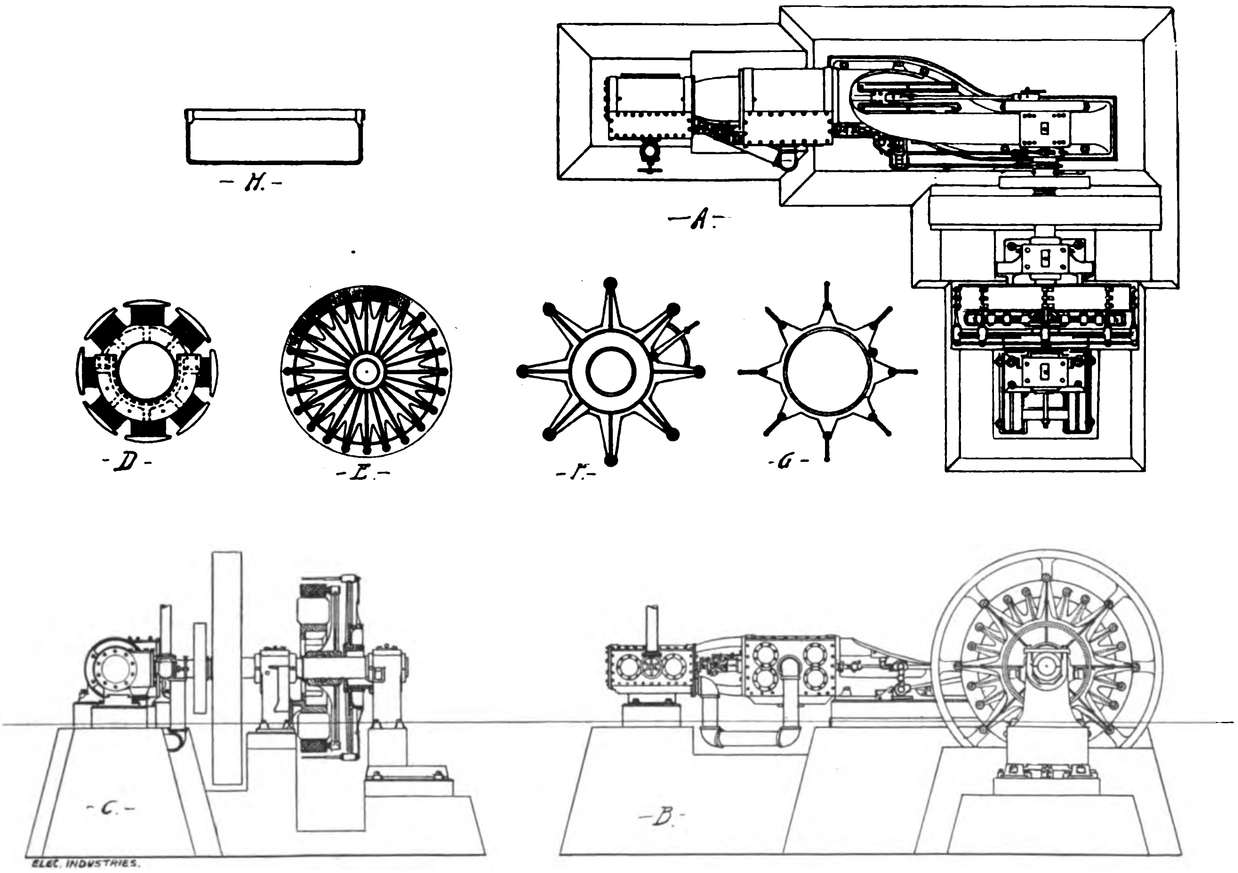
The death of William J. Richardson, secretary of the American Street Railway Association occurred at Brooklyn on April 26. He was one of the directors of the Atlantic Ave. Railroad Co., and was well known to the street railway men of the country. He was born in Albany, N. Y., in 1849 and received his education at that city. Since 1864 he had made his home in New York and Brooklyn. He was greatly respected both by the officials and employes of Atlantic Ave. road.

The Dayton City Railway, Dayton, O.

The history of this railway system began in 1868, when the Dayton Street Railroad Co., whose lines form a part of the present consolidation, was incorporated. This was one of the first in operation and continued as a separate line until the incorporation of the City Railway Company in 1893. The lines of the Dayton and Soldiers' Home Railroad Co. and the Fifth Street Railroad Co. form a part of the street railway system of the Dayton City Railway Co. The road comprises about twenty-five miles of track and the lines are now being extended. The road is operated by electricity and the new power house and its equipments, which are illustrated in the accompanying engravings, exhibit a number of novel features.

The power station is constructed of brick with trussed roof, which gives a clear space for the traveling crane. Windows above and at the sides give an abundance of light and ventilation. The foundations for the machines were built of brick with heavy cap stones upon which the heavy electric generators and engines rest. The combination consists of tandem compound horizontal engines direct connected to multipolar generators of the internal pole type. This combination is comparatively new and to many will possess more than usual interest.

The generators are multipolar, having six internal poles and the armature revolving about them. They were manufactured by the Siemens & Halske Electric Co. of America at the Chicago works. The details of this combination are shown in Fig. 1. The fields are supported on the base of the central pillow block by a bracket which is a part of the field yoke. The fields are of soft forged iron and the windings are made of insulated wire. After the fields are placed in position the shoes of the shape shown in outline are bolted to the ends of the pole pieces. The magnetic circuit, it will be noticed, is short and continuous. The fields radiate from a common center which requires a minimum amount of iron.



A—Plan of engine and generator. *B*—Elevation. *C*—Cross section. *D*—Poles of generator. *E*—Armature. *F*—Brush star. *G*—Star for raising Brushes. *H*—An armature winding.

FIG. 1.—THE DAYTON CITY RAILWAY, DAYTON, OHIO.

The armature is of the simplest possible construction. A circular ring of laminated and insulated iron bolted to the arms of a star which is keyed to the engine shaft forms the core. The windings are copper bars formed like the three sides of a rectangle as shown in detail in Fig. 1. These windings are carefully insulated and then placed over the core, and the commutator segment is soldered across the two ends on the outside. The winding and segment make a complete circuit around the core of iron. Every part is carefully insulated from every other. The windings are much more numerous than would be possible in a smaller armature, and the speed of each is greater, cutting more lines with the same speed of the engine. On this

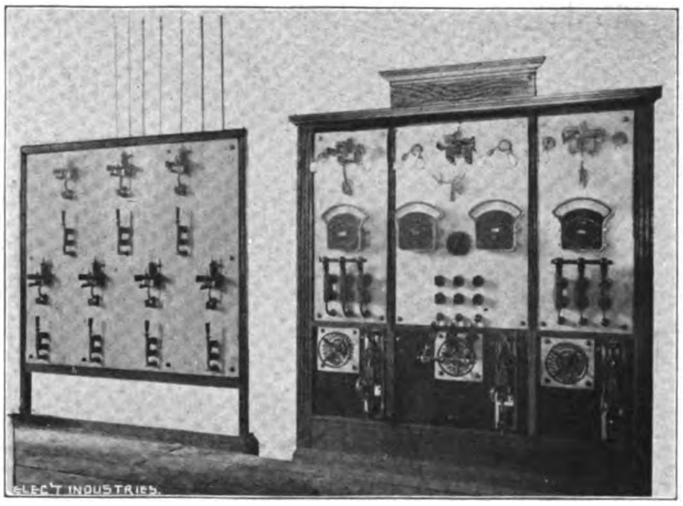


FIG. 2.—THE DAYTON CITY RAILWAY, DAYTON, OHIO.

account this type of generator is especially adapted for slow speed engines.

The large diameter of the armature gives room for a greater amount of copper than any other type. The armature is well ventilated. A single segment or winding may be replaced without disturbing any other. The brushes are supported by the arms of a special star, shown in Fig. 1, on the side of which is a rack moved by a pinion on the shaft of a hand wheel. A turn of the wheel raises the brushes from the commutator. By means of another similar combination the brushes are shifted in either direction. They are all controlled by a single movement, and are under instant command.

The engines, which are of the tandem compound type, were built by the Buckeye Engine Co., of Salem, O. Each engine has a high pressure cylinder seventeen and one-half inches in diameter and a low pressure cylinder thirty and one-half inches in diameter, with a thirty-three inch stroke. At 130 revolutions per minute and a pressure of 125 pounds the engines are rated at 550 horse-power when running with condenser. Higher steam pressure and multiple cylinder engines have been advocated by this company on account of the economy secured. In street railway service, which does not permit of the same economy being reached that is obtained in plants operating under a regular load, the best results are sought, and this engine was selected with a view to economical operation. The compound type is considered preferable to the triple or quadruple expansion engines whose more complicated apparatus is seldom fully understood by the engineer in charge. What advantages in economy might be secured in the multiple cylinder engine are not considered sufficient to warrant the increase of cost of equipment and greater expense of attendance. The compound engine is being more generally used in power stations. Whether these engines are run condensing or non-condensing usually depends on the convenience of the water supply. The saving by the uses of the compound engine over the simple engine is estimated from ten to forty per cent, according to the conditions under which it is operated.

The first compound engine built by the Buckeye Engine Co. was constructed in 1879, and tests made of the engines built in that year showed a remarkably good efficiency. The steam consumption per horse-power would have been creditable to engines with a greater number of cylinders. The company has since greatly improved the engine as experience and increased knowledge have shown where improvement was possible. The engine here used is the standard type of compound engine now made. The arrangement of the cylinders may be changed as circumstances may make advisable. This engine has what seems the more symmetrical arrangement, the low pressure cylinder at the center. The steam pipes leading to the engines have curves of long radius in place of square elbows, a method which offers less resistance to the steam.

The engraving, Fig. 3, shows the engine room after the machines were started, but before the interior was completed. The floor had not been laid, the steam pipes covered nor any of the finishing which give an engine room a completed appearance. The boiler room contains a battery of return tuburlar boilers manufactured by Brownell & Co., of Dayton. These boilers are 72 inches in diameter and 18 feet long, and contain 60 four-inch tubes. There is sufficient space for additions to the present battery of six boilers when the demands of the road make it necessary. The dynamo room has also space for at least two more units of the size now in use.

The feed water heaters and pumps were furnished by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O. The exhaust steam from the pumps and the Wheeler surface

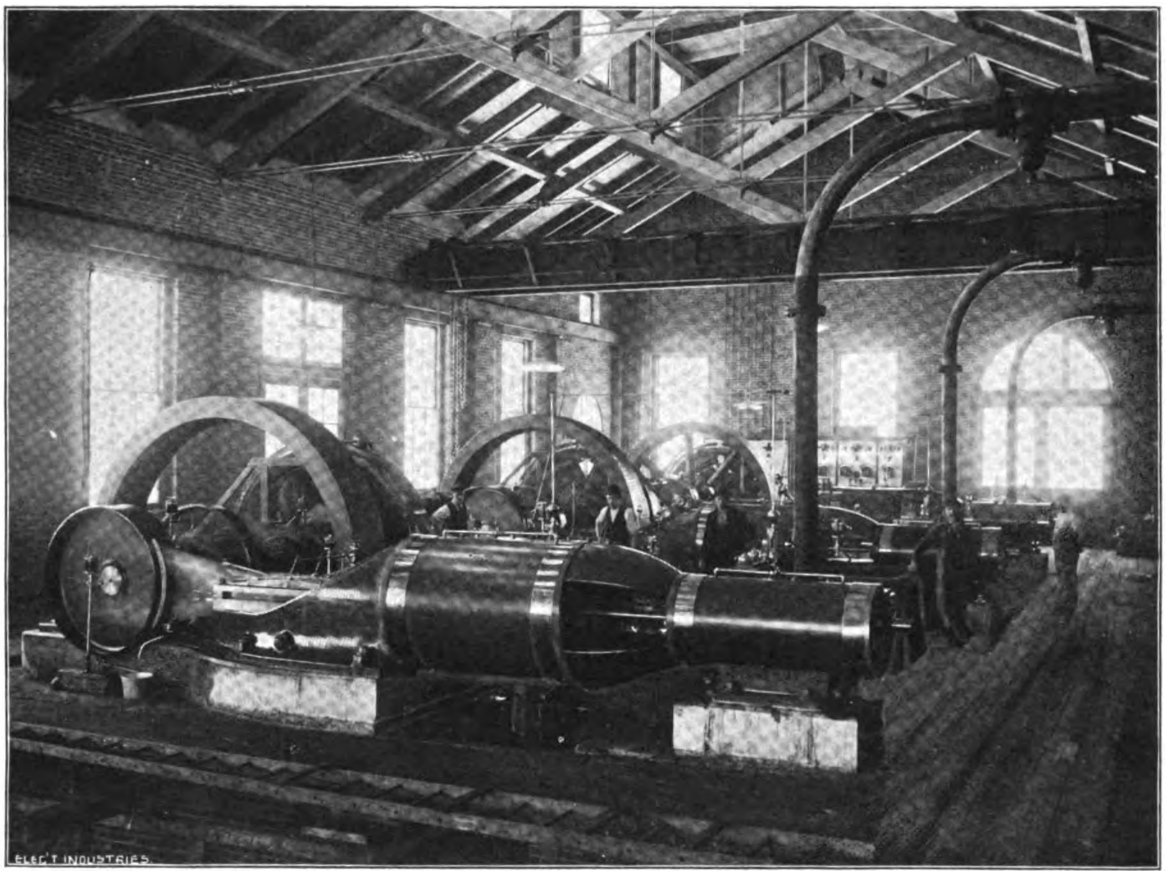


FIG. 3.—DAYTON CITY RAILWAY, DAYTON, OHIO.

condensers is used in the feed water heaters. The entire equipment was selected with a view to the most economical consumption of fuel and a reliable power always at command. The plant was designed by Mr. Bert L. Baldwin, of Cincinnati, O.

One of the great features of the Cotton States and International Exposition will be the electric fountain, authorized at a recent meeting of the executive committee of the Exposition company. The fountain will be designed by Mr. Luther Steringer, who designed the electric fountain at the World's Columbian Exposition. It is proposed to save the fountain rise from the middle of the grand basin, in front of the Machinery and Forestry buildings. From this point it will be visible all over the Exposition grounds, and the effect produced by columns of water with infinite variety of color and brilliance will be exceedingly beautiful.

The Future of the Steam Engine.—II.

BY FOREE BAIN.

The factor of safety of a steam boiler in daily use, decreases in value with each succeeding day, until the factor with the boiler finally disappears. This result is sure to follow if the boiler remains in service long enough. The deteriorating effects which are constantly in action in a boiler, are complicated and complex in their cause and nature.

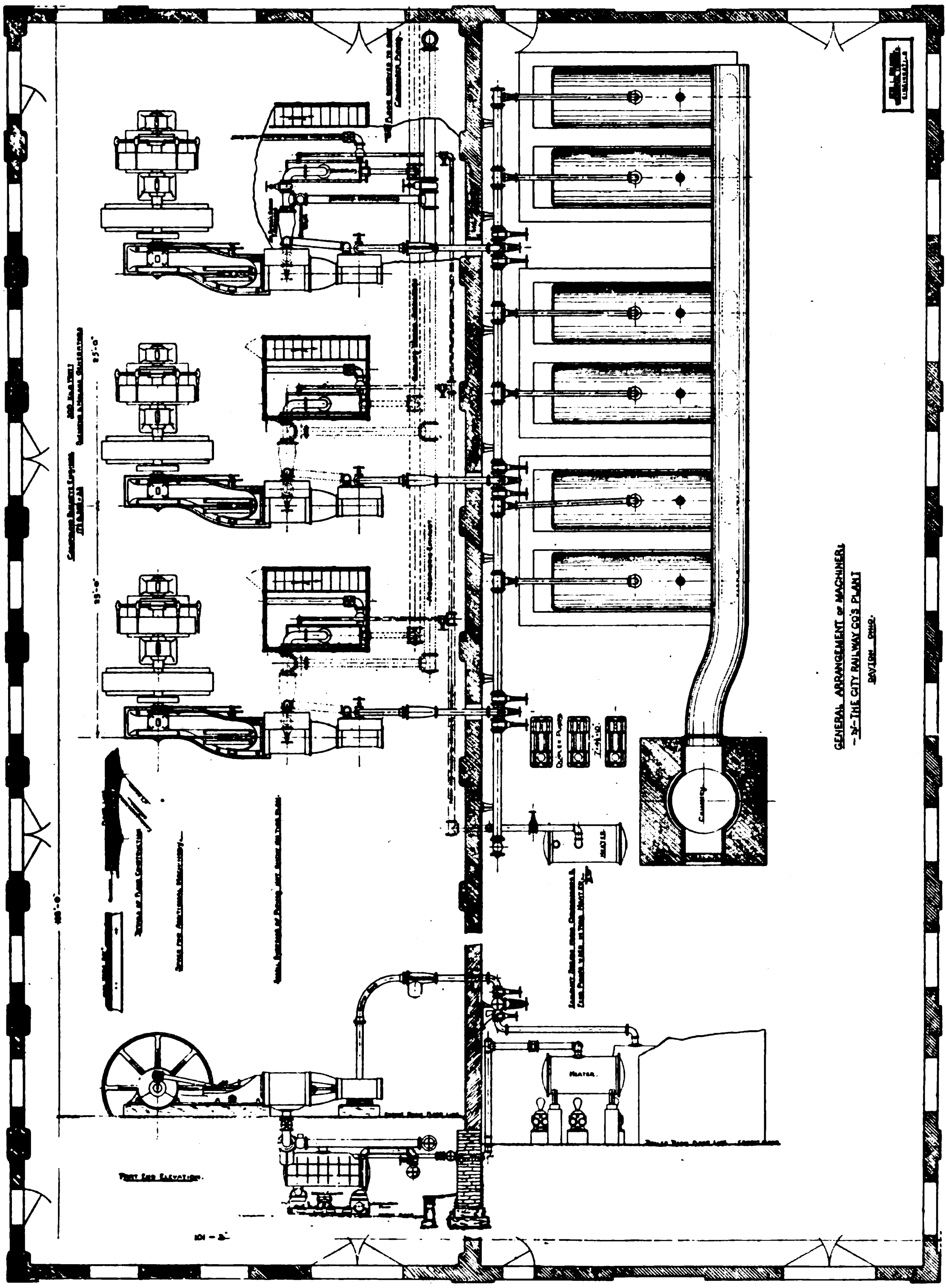

GENERAL ARRANGEMENT OF MACHINERY
—OF THE CITY RAILWAY CO'S PLANT
DAYTON, OHIO.
HEATER.
Front End Elevation.

FIG. 4.—DAYTON CITY RAILWAY, DAYTON, OHIO.

It has occured to me that electricity probably contributes more to the destruction of a steam boiler than is usually understood. There are several conditions present in a boiler under steam, which will produce a difference of electric-potential and cause electricity to flow.

Electrolytic disintegration will produce rapid destruction of the metal electrodes between which electricity is made to pass. Unlike plates of metal, such as copper and zinc, placed in a proper electrolyte assume a difference of electric potential and urge a current of electricity through the electrolyte, proportional to their differences of potential and inversely proportional to the resistance of the electrolyte, as is well understood. The electricity when passing through the electrolyte in this manner has the power to transfer portions of the metal from the pole from whence it comes, and to deposit it on the pole to which it approaches, or to deposit its equivalent in solution of the electrolyte. When two plates of the same metal are similarly placed in a proper electrolyte a difference of potential can be produced by the differing temperatures to which the electrodes are heated, with a result similar to that just described.

The thermic effect, or the process of boiling water in a boiler, by which the boiler and the contents are heated to unequal temperatures, produce difference of potential which causes the flow of electric currents, their direction being to decompose the hottest portion of the boiler, by a process similar in its nature to that of electro-plating. The upper strata of water and the boiler shell above being kept cooler by the admission of water and the lower portion being directly over the fire, a very considerable difference of temperature is maintained, with a corresponding difference of electro-potential, notwithstanding the circulation of water which tends to neutralize this effect.

In addition to and quite independent of the electro-thermic effect, there must be a galvanic action, stimulated by the heated electrolyte and directly produced by the chemical composition of the water, similarly and equally destructive in direction and manner, both effects assisting in weakening that portion of the boiler which is subjected to the highest temperature.

Thermo-chemical effects which tend to decompose and oxidize these heated portions are intensified by the presence or effect of the electrolyte and galvanic actions. In addition to these, the molecular structure of the boiler shell is greatly strained and weakened by constantly changing conditions by expansion and contraction which are responsive to the equally changeable draughts of heat and cold under the boiler.

A boiler under steam when properly insulated from the ground can be made to exhibit great power as a producer of static electricity; but it is not clear that this effect contributes in anyway to destroy a boiler, but it illustrates the complex conditions under consideration, and that the conditions are such as to produce electro-thermic, galvanic and static electricity, or electricity exhibiting all of these characteristics.

It will not require much reasoning nor much erudition on the subject to arrive at the conclusion that the cold hydraulic test of the inspector does not indicate in any manner the presence of or the rapidity with which these processes are going on within a boiler. It is not the purpose of this article to go minutely into the subject relating to the various causes which contribute to the rapid destruction and consequent danger of a boiler. It is sufficient to say that it is dangerous and that would be a very reasonable cause for its universal condemnation.

The efficiency of a boiler is low enough for all practical purposes, but the loss " up the chimney " is not so great as many suppose; however, the loss in the steam engine and boiler combination is so great as to entitle it to be relegated to innocuous desuetude.

The losses are to be found in unconsumed gases, imperfect combination, radiation, condensation, and the loss of potential energy expunged at the exhaust. These losses are so great compared with the utilized energy that it is a matter of wonder how it has been possible for a people so enlightened and advanced in other directions to have been content to use such an inefficient device for so important a duty as to keep the wheels of industry in motion, and which itself is so inconsistent with the advanced economies in other directions. There is probably not a more incongruous example in applied mechanics than this. Sufficient time and consideration cannot be given to the proper discussion of the subject in all of its details, and I must be content to call attention only to the various features inconsistent with the economical application of the steam engine and boiler.

It will readily be granted that it is dangerous; that it occupies too much valuable space; that it is by no means neat; that its use causes too much dirt to be cleaned away; that its installation is expensive; that it requires too much vigilance and care; that its deterioration is too rapid; that its efficiency is much too low, and that we pay dearly for the results obtained by its use. What shall we use in place of the steam engine?

The signs of the times point directly to the fact that its successor is on the highway, marching rapidly toward success; it is growing in strength and confidence with each forward step; it will soon be ready to make the attack, and when it gains the confidence of the public, by an exhibition of its reliable performances, the enemy will be quickly and effectively routed. The demand has been made; the inventor's skill and brains are at work; the results are sure to be satisfactory.

About ten years ago, Dr. Siemens announced his belief, before the Royal Society of England, that the gas or oil engine would some day supersede the steam engine. His opinion was based upon the general comparison of the characteristics and possibilities of the two devices. He could see great possibilities in the future for the former, but thought that the latter had about reached its limit of improvement.

The " Otto Cycle " gas or gasoline engine, in which two strokes of the engine are necessary to complete a cycle of operation, is the class with which we are most familiar. It is probably safe to say that at least ninety per cent of the engines on the market today are of this class. This type of engine has been in practical operation for about twenty years, with more or less success. It would have entirely succeeded the steam engine long since had it not been for the fact of its irregular motion and uncertainty of action.

There have been a great number of workers, and there are today a greater number engaged in the task of improving or producing a satisfactory gas engine.

By far the greatest per cent of the number are endeavoring to attain this result by the employment of the Otto cycle. It cannot be said that this result is impossible, but that it is more likely to happen that success will be reached by some independent genius who will be brave enough to leave the thrashed straw and look for food for his inventive appetite in other fields.

The Century Magazine for April contained a very interesting article on Tesla's Oscillator and Other Inventions by Mr. T. C. Martin. The article is illustrated by numerous engravings in which appear portraits of several well-known authors and actors. It is written in a style that is easily understood by the average reader. The facts present will be found of interest by any one interested in the progress of the science of electricity.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

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The difficulty which members of the committee on data of the National Electric Light Association reported in securing the information for the last report of the committee, was the fact, that the central station companies themselves did not possess the information desired. Some acknowledged their inability to get the information, others that they did not know how, but as a general thing all were willing to assist in the effort made, to secure reliable information for the association. It was suggested at the last convention that the committee get up a standard set of blanks for recording the data and that the instructions for keeping the records should be printed and sent out with the blanks to the central station companies. Such a plan would remove a part at least of the difficulty heretofore encountered in procuring the reports from the companies. It affords also a uniform system of keeping the accounts and would simplify the compiling of the reports. The next report of this committee would undoubtedly be more complete and would show in place of a few insolated cases something more like an average of the industry. The lack of economy, the high cost of the production of electricity as shown in the twenty-four plants from which information was given, would seem to arouse all central station managers to a greater interest in this subject. It is difficult to see how a company could pay dividends while producing but 30 watts from a pound of coal, unless some accommodating neighbor furnished the coal, put it in the boilers and carried away the ashes. Economy is to be produced not by the installation of the most modern high class apparatus but in the operation of the plant, the control of the load and the efforts made by the management of the company to secure customers or means for using the surplus power during the period of light loads. The collection and publication of these central station records will lead to an exchange of ideas, the co-operation of central station managers for the improvement of the industry and the raising of the commercial production of electricity to a position where it will be able to override all competitors. The manufacturers give us efficient boilers, engines and dynamos, but there is something wrong between the coal pile and the customers' meters. How to remedy this is the most important question before the central stations at the present time. The commercial production of electricity has to be conducted on the same basis as any other business in accordance with business principles. The novelty has worn off and the bare facts stand forth to be dealt with. Such facts as the commissioners of the state of Massachusetts give in their annual report show that the business as a rule is unprofitable in that state. Less than one-half the companies paid dividends during the past year. The data secured by the commission is not as complete as it should be but it is nevertheless an addition to present information on the subject. The co-operation of central station managers on some systematic plan during the present year will give a more complete report and will enable the committee to present the matter in a clearer manner at the next convention.

How much knowledge is it necessary for an electrical mechanic to possess, is a question often asked. This question is usually answered in the ambitions of a progressive young man who seeks to learn as much as his circumstances will permit about the trade or vocation he has taken up. The best manner of doing things, certain facts about the work and a miscellaneous lot of information which at some future time will prove most valuable may be picked up in the shop or on the line. By reading the best books on the subject or subjects connected with the trade additional information is secured. The study and attention to the work in hand is bound to tell, and when there is an opportunity for advancement the young man best informed about his work stands the best chance of the better position. One of the first things learned by a mechanic should be mechanical draughting, so that he will understand any plans that may be put before him. It is as essential at the present time as to know how to handle tools. Since work is now done by the piece, a workman produces the single part without reference to the rest of the machine. The plan that is placed before him should tell him everything necessary for doing his part of the work. The technical schools which have been established in nearly all the large cities and the addition to the regular courses in our public schools of studies especially adapted to the needs of the mechanic have been beneficial to a large number of workmen. Persons to whom the care of machinery is intrusted should know something about that machinery, how to operate it to get the best results, how to repair it if it gets out of order, and especially how to run it so that repairs will seldom be needed. Electrical machinery is new to many workmen. Its operation is somewhat of a mystery. Those who have the care and management of such machinery should know enough of the construction and operation to handle them intelligently, whether it is in the shop, central or power station or on the electric railway. A little knowledge of the machine will often save an armature or prevent other serious mishaps.

Switchboard construction has undergone a marked evolution during the past few years. The aim has been to reduce the number of conductors and thus secure a greater simplicity, to increase the durability of the board and to decrease the resistance of the conductors. All combustible material is now discarded. For the face of the board, slate or marble which has shown under tests the necessary qualities is used. In the place of wires and cables so common a few years ago heavy bars are employed. The whole is designed so that the fewest possible number of joints are found in each conductor. Connections are made by terminals formed on the ends of the bars and which are held securely in place by lock nuts. The instruments are made to conform to the methods employed in other parts of the board. Their terminals are made either for connection on the back or front of the board and in such a way that in passing through the board no extra joint is necessary. Modern practice has developed the several parts of the board with a view to reducing what otherwise would be a confused and complicated mass of wires to a simple and orderly arrangement that places everything in view and permits every part to be readily inspected. The absence of insulating converings gives the conductors better ventilation and where heavy currents and at times extra heavy loads are being carried the perfect ventilation of the conductors is important. The practice of the switchboard is extending to other parts of the station. The concealment of the cables from the machines to the board and the feeders as they have the building is an arrangement that does not encumber the station and gives its interior a neat appearance.

THE first of a series of articles on Factory Practice in the Design and Construction of Dynamos appears in this number. The subject and the manner in which it is presented will, we feel sure, meet the wishes of a large number of our readers. Without an elaborate introduction the author enters at once upon the description of a type of dynamo and describes its different parts, their relation to each other, the determination of sizes and manner of construction. The usual introduction, a mass of definitions, formulæ, etc., that cannot be fixed in the mind but only serves as a huge stumbling block, has been omitted. Such definitions and descriptions as are necessary to an understanding of the subject will be given as the terms occur. The articles will be fully illustrated by original cuts and every part made as clear as possible. On any points not understood by the reader the writer will be glad to answer any questions. The preservation of the succeeding numbers of ELECTRICAL INDUSTRIES will give the subscriber a complete work on this subject.

How Magnetism Affects Your Watch.

The general use of electric machinery, which has been brought about within comparatively a few years, has in many ways changed the previous arrangement of things. One of these changes has been in the manufacture of watches. When the first lighting plants were put in, they were visited by nearly every one in the vicinity. Then watchmakers began to receive complaints that their watches would not keep good time. They would go too fast for a time and then would go too slow, and vice versa. It was some time before the real cause of the trouble was discovered; the parts of the watches had become magnetized by the powerful fields of the dynamo electric machines.

To demagnetize the watch would bring it back to its original condition, but a second visit to the lighting plant would again spoil its time-keeping qualities. The public soon learned to keep their watches away from the dynamo, and the watchmakers have since found a way to make watches that are not affected by magnetism. Comparatively few of the time-pieces in use, however, are non-magnetic, and the average watch is subject to these seasons of fickleness.

The exceedingly fine and exact construction of the watch is not realized by the average possessor of the article. An examination of the works of a watch shows the mechanism as now constructed, although very small in size, to be most accurately planned and executed. The changes of temperature are provided for, so that the movement is automatically adjusted. The main spring and train of gears are usually concealed, while the balance and hair springs are in full view when the case is open. Upon the regularity of the movement of the balance depends the time-keeping quality of the watch. On looking closely at the balance you will observe that it is not a complete ring, but two halves supported at one end. These rings bear a number of large headed screws, placed at irregular distances, which give it the exact weight and balance required. These half rings will also be found, on looking closely, to be composed of two metals so closely joined that a difference in color alone give evidence of the fact.

This arrangement of iron and brass, on account of their different co-efficients of expansion and contraction with changes of temperature, has been so carefully constructed that with changes of temperature the balance assumes such forms as to give it a uniform rate of motion. The parts affected by magnetism are the balance and springs. The balance in an ordinary watch moves five times a second; 18,000 times an hour, and 432,000 times each day. But a slight change in the forces that move it are necessary to make a difference of several minutes each day. As the balance moves back and forth the magnetism of the mainspring is pulling or pushing it. If this force was constant and always in the same direction the watch would run uniformly. Such, however, is not the case. When the mainspring is tightly wound its magnetic poles are in a certain direction and in unwinding they are constantly changing, so that the direction of this force is also constantly changed. The effect on the balance is such as to cause the watch to run too fast sometimes and too slow other times.

Non-magnetic watches are made with these parts of a non-magnetic metal so that they are not influenced by electric machinery. For testing watches a small compass is used. When placed over the balance the needle will vibrate with the motion of the balance in proportion to its magnetism.

Electric Power on the New York Central.

The New York Central & H. H. Railroad Co. expects to equip with electric power shortly a line between Buffalo and Niagara Falls. It is expected that a number of trains operated by the overhead trolley system can take care of the excursion business between the two points at a much less expense than by the use of the regular locomotives. The company feel bound to make some such move to prevent electric street railways securing the passenger traffic. The modification of the track for electric power would be a small item as the bonding could be done while the road is in use. Power may possibly be secured from the Niagara Falls Power Co. The fare between the two points will be reduced, modern coaches will be used and passengers will have the pleasure of viewing the river and falls without the dust and smoke of the steam locomotive.

Texas Gas and Electric Association.

There has recently been sent out by a committee composed of a number of prominent lighting men of Texas, a call for a convention of the managers, superintendents, and other officers of the gas and electric lighting companies of Texas. The meeting is to be held at Mason's Hall at Houston, Tex., on May 22. At this meeting it is expected that an organization will be affected on lines similar to other organizations of this kind. The meeting is to be strictly a business affair, and the invitation is extended to all interested in the above companies or industries.

The Sacramento-Folsom Power Transmission Plant.

One of the most interesting fields in which the electrical engineer is now working is that of the electric transmission of power. The new problems that are presented and the possibilities of the system make it an attractive field. The new plants of this kind which have been erected in various parts of the country to utilize the water powers located at some distance from business centers have shown the many advantages and especially their commercial success. These plants show also a variation in distance to which the power is transmitted, the methods employed for transmitting and generating the power and details of the systems. One of the most interesting of the plants of this kind recently completed is what is known as the Sacramento-Folsom Transmission Plant. It receives its power from one of the largest water powers in California.

The system has been constructed by the Sacramento Electric Light & Power Co. The power plant is located at Folsom on the American river. The development of this water power dates back to 1866, but its present large plan has only been undertaken since the great advantages of the electric transmission of power have been appreciated.

The work as at first conceived embraced a dam across the American river near Folsom, and the utilization of the water primarily for power purposes; and, in the second place, for the irrigation of the surrounding country. The plan was modest in its proportions and remained so for many years, but the introduction of electricity immediately magnified it into a grand scheme contemplating the utilization of about 5,000 horse-power for transmission purposes and 1,200 horse-power for use in the state prison located by the side of a special state power house.

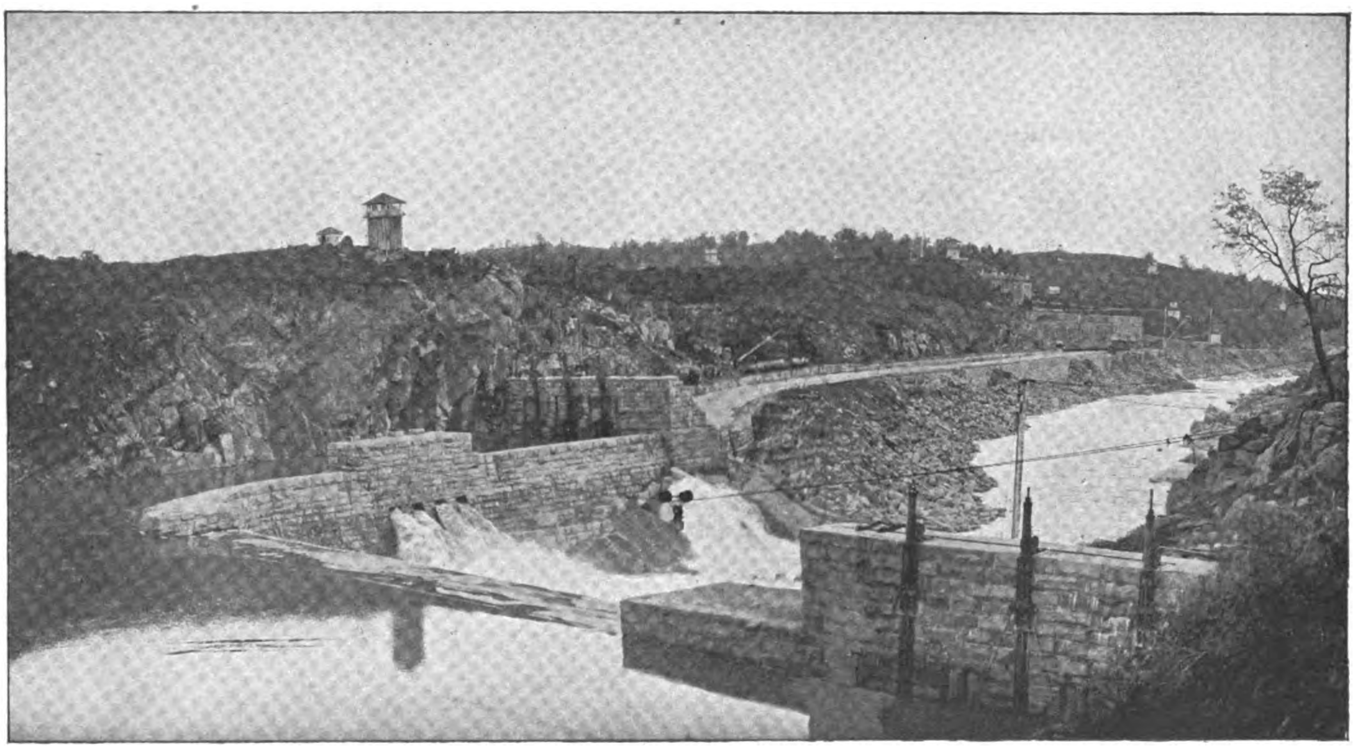


FIG. 1.—THE SACRAMENTO-FOLSOM POWER TRANSMISSION PLANT.

In carrying out the first scheme the state of California contracted with the power company for water privileges and certain grants of land for prison buildings agreeing to supply in return convict labor for the construction of dam, etc. In 1888 a new contract was effected, the size of the dam and canals as indicated in the original plans was greatly increased, and under these new plans the work is now nearly completed. The dam is constructed of solid masonry, being built of granite laid in cement. It is 650 feet long, 89 feet high in the centre, 87 feet wide at the base and 25 feet wide at the crest. By the aid of a wooden flash board the height of the dam may be increased during low water six feet. The dam has a storage capacity of 13,000,000 cubic yards of water. At each side of the dam are granite bulkheads and three head gates operated by hydraulic machinery. Each headgate is sixteen feet wide. A canal on the east side leads to the power house two miles distant. The canal on the west side is not yet completed. This is intended principally for irrigation purposes. It is forty feet wide at the top, thirty feet wide at the bottom and six feet deep. The east canal is larger and has a capacity of 87,000 cubic feet of water per minute. It lies partly in the rock, partly in earth excavation and the balance in masonry and earth cuts.

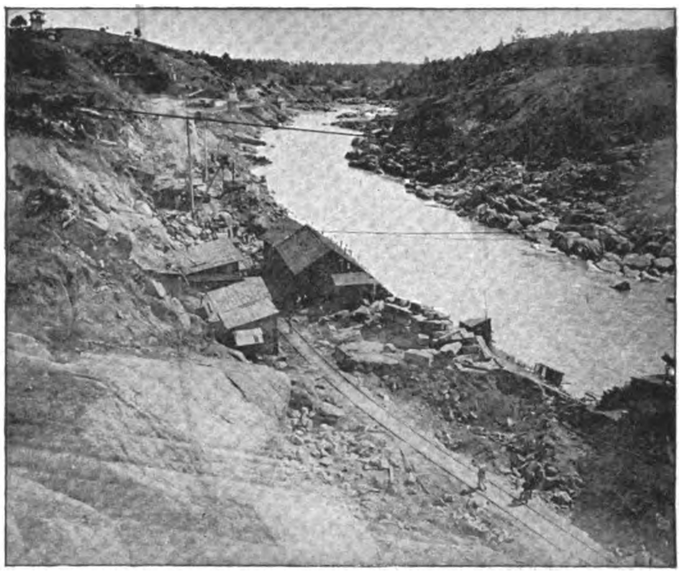


FIG. 2.—THE SACRAMENTO-FOLSOM POWER TRANSMISSION PLANT.

The power house of the Sacramento Electric Light &

Power Co. is located on the river bank where there is a fall at high water of fifty-five feet. The canal widens out at the power house to 100 feet wide and 12 feet deep. The canal is here divided into two parts, each provided with a gate connecting with the lower river through which all debris may pass when it is desired to clean out the canal. The power house is constructed of granite and built in a solid manner.

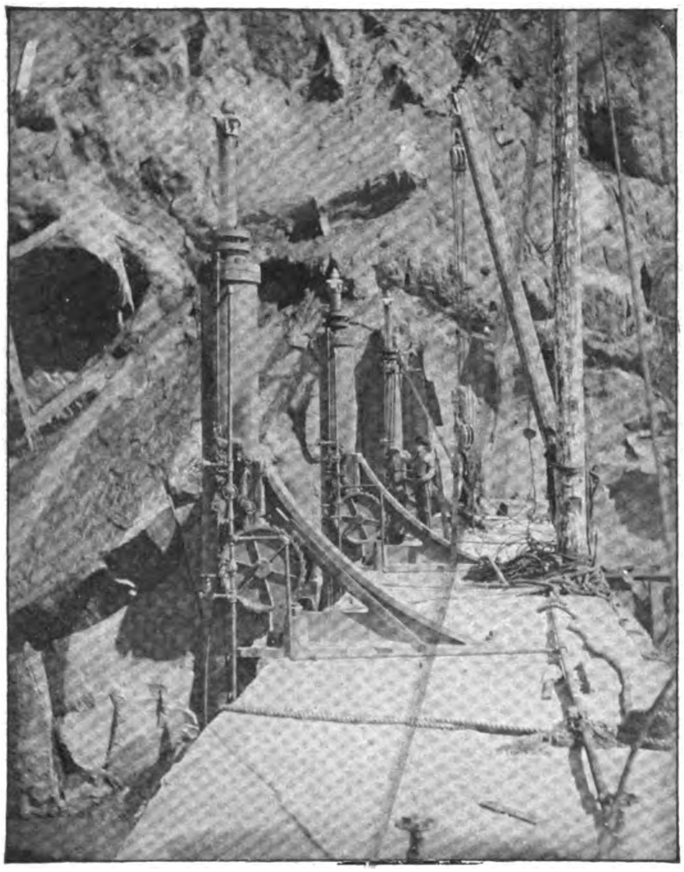


FIG. 3.—THE SACRAMENTO-FOLSOM POWER TRANSMISSION PLANT.

The contract for the entire mechanical and electrical equipment was awarded to the General Electric Company, in September, 1894. The contract for the hydraulic apparatus was let to the S. Morgan Smith Water Wheel Co. This apparatus will consist of four pairs of wheels of the McCormick horizontal shaft turbine type, enclosed in steel cases, having steel inlet pipes, eight feet in diameter and double discharge tubes. By this arrangement in pairs, the end thrust is neutralized and sufficient power and speed is developed to allow of direct connection to the generators. The governors used will be of the Faesch-Picard type and will be supplemented with heavy fly wheels on the water wheel shaft. Each pair of wheels will have a capacity of 1,260 horse-power at 300 revolutions per minute. They embody the latest ideas in hydraulic practice and are among the largest in use. They will be operated under a head of 55 feet. The hydraulic plant also includes two special horizontal wheels for the exciters. The water after having passed the turbines will be discharged through tunnels under the power house into irrigation canals for distribution over the country south and east of Folsom. The generators will be four in number and will be of the General Electric three phase alternating current type generating current at 800 volts potential. The armature shafts will be directly connected to the shafts of the wheels by means of flange couplings. Each generator will have a capacity of 1,000 horse-power and will weigh about 30 tons. They will be the largest three phase generators yet constructed.

The wheels and generators will be located on the first floor of the building sixteen feet above the level of the water in the tail race, but will not occupy the same room. Between the wheel room and the generator room a heavy masonry wall has been built.

The step-up transformers which will transform the current generated to 11,000 volts, will be located in the second story of the power house. The conductors will be carried on two pole lines to the Sacramento transformer station, two lines being erected to prevent a shut down should one line get out of order. Each pole will have two cross arms and will carry two circuits of three wires each. The insulators used are porcelain of the double petticoat pattern. The transformer sub-station is to be divided into four parts —the transformer room, the motor, railway, and arc dynamo room, the shop and test room and the store room.

By means of transformers, motors and generators current will be furnished of the various potentials and kinds the diversified interests of the city demand. Motors will furnish power for direct current generators which will supply power for the railway and commercial motors, arc machines etc.,

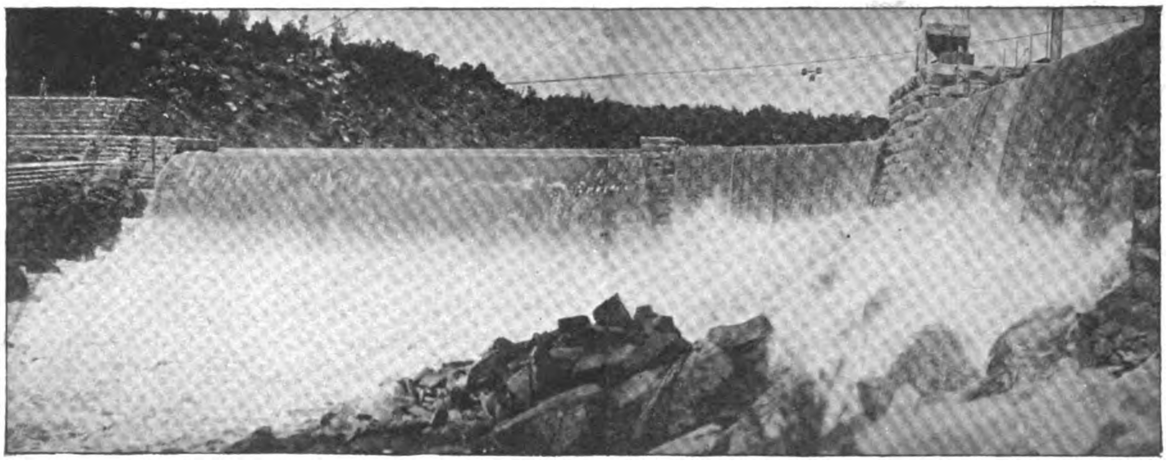


FIG. 4.—THE SACRAMENTO-FOLSOM POWER TRANSMISSION PLANT.

Every employer should encourage the reading of good trade papers by his employes. What benefits them benefits him, and the employe who does not profit by the careful study of a paper in his line is either very stupid or has stumbled upon a very stupid paper.—Am. Miller.

LESSONS IN PRACTICAL ELECTRICITY

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Storage Batteries and their Construction—III.

BY J. K. PUMPELLY.

A knowledge of chemistry is so necessary to an understanding of the construction of storage batteries, that, the writer has assumed that the readers understood the chemical symbols used to express the changes that take place in the condition of the lead in making a battery. As some who are interested enough in this subject to read these articles may not be students of chemistry, especially of electro chemistry, I will explain briefly the meaning of the symbols so constantly used, when describing the changes that take place in forming and charging a storage battery. Thus the letters Pb. stand for the metal lead and when used by a chemist always represents lead. O is used as a symbol for oxygen. When the oxygen and lead unite and form lead oxide, to express the combination $Pb.O$ is used, indicating that one atom of oxygen unites with each atom of lead. If two atoms of oxygen unites with each atom of lead forming lead peroxide, the symbol is written $Pb.O_2$. The figure 2 indicating the two atoms of oxygen in the combination.

Investigators and students of this subject have varied the formula used to express the changes that take place in an accumulator while being charged or discharged to accord with their theories, but lead is the base that is changed. It becomes peroxide of lead $Pb.O_2$ on the positive pole. It may have been the simple oxide of lead $Pb.O$ as the monoxide, or the protoxide of lead, like the litharge, and red lead used in the Faure system, what is called the paste battery, or it may be the form of lead oxides and sulphates, that take place in forming the Plante battery. Still in all the varied forms of accumulators where acids are used in the electrolyte or battery liquid metallic lead is the material first acted upon by the gasses set free, when a current of electricity passes through the liquid.

Plante's theory is the simplest one for us to understand, which is this: "Under the action of the primary current, the water is decomposed; the oxygen peroxidizes the positive electrode, and the hydrogen goes to the negative electrode, which is always more or less oxydized by the exposure to the air." Undoubtedly many other changes take place, sufficient to make the action of a storage battery a mystery to any student of electro chemistry, but practically we have made no farther advance than the carrying out of Plante's theory to more practical and commercial results. For instance, we do not depend on the negative electrodes being merely oxydized by exposure to the air, as Plante says, but we find chemical means to put the negative electrodes in a condition to absorb hydrogen from the moment, that decomposition of the water in the electrolyte begins. We know that oxygen is a fierce and determined fighter, will force its own way and hold on to what it gets, thus forming with the atoms of lead, whether in a pure state, or as a sulphate, o rnitrate or chloride. Oxygen will drive them all out, and from not only an oxide of lead but a di-oxide and perhaps a third oxide and so on.

Hydrogen is more gentle in its actions, and as we say is absorbed, or occluded, into the negative electrode, hence we strive to make this electrode as spongy or absorbent as possible, so that it may take to itself, or absorb as great an amount of hydrogen as the decomposed water can furnish. In this way we reach the desire of the battery maker. This aim, that set of lead electrodes the positives of which shall become most highly peroxidized in the shortest time, and a negative electrode that shall be in the best condition to absorb hydrogen in the shortest time is not all that receives the attention of the battery maker. A point quite as important is to have the electrodes made in such a way mechanically, that they can be depended upon to do this work of taking up oxygen and hydrogen and giving it off again when called upon in the form of work continuously for an indefinite period. This is being accomplished today in a way never attained in the past and we will attempt to study the different methods now pursued in the construction of modern batteries.

What work has been done thus far and what promise to be done in the near future forms a most interesting study. Our next paper will take up the forming and charging of the improved storage battery, and also the mechanical construction of the best lead electrodes. A former paper of this series gave by drawings some idea of the method Plante, who experimented before dynamos had been perfected, used. That is forming and charging from banks of primary batteries. Now the dynamo gives us any current we need and as constant as we need, so when our plates of lead, or our electrodes are made and assembled in glass or hard rubber jars, and the jars filled with sulphuric acid (SO_4H that is, each molecule is made up of one atom sulphur, four of oxygen and one of hydrogen) and water, we need only to connect the positive pole of the dynamo to the positive of our battery and the negative to the minus or negative pole of the dynamo, and regulate the current by certain rules which will be explained later to charge the battery. When the electric current is allowed to pass through the batteries, the changes in the appearance of the lead plate, will in a few hours be quite marked.

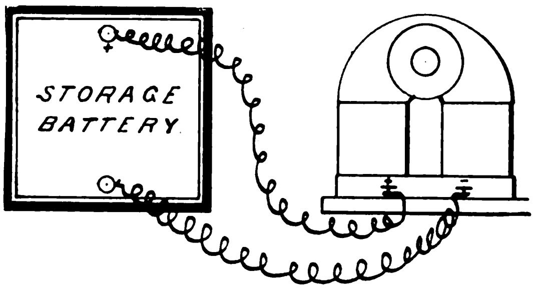


FIG. 1.—STORAGE BATTERIES AND THEIR CONSTRUCTION.

The best method of charging a storage battery has required a considerable study so as to get the best results. To charge them at such a rate as not to injure the plates but will produce the desired changes. It should always be remembered that we are not pouring something into a storage tank to be taken out when desired, as seems to be the opinion of some, but that a very sensitive process is being gone through that requires care in conducting. This process will be described, the method of connecting and the rules which have been found best in practice will be given in the next article.

Ohm's Law.

Many of the questions which arise in electrical practice are answered by the use of the formula that expresses the relationship of current, electromotive force and resistance, what is known as Ohm's law. The importance of this law is difficult to express. It enters into nearly every electrical computation and is more widely used than any of the many other electrical formulæ. It is one of the most useful rules and should be so firmly fixed in the memory that it will never be forgotten. It matters not what position one may occupy in the electrical field, dependence upon this rule for the solution of many of the problems that arise is certain.

This law, which was made known to the world by Ohm in 1827, thus expresses the relationship of current, resistance and electromotive force.

(1.) The current strength is equal to the electromotive force divided by the resistance.

(2.) The electromotive force is equal to the current strength multiplied by the resistance.

(3.) The resistance is equal to the electromotive force divided by the current.

For greater convenience the algebraic formulæ are used $C = \frac{E}{R}$; $E = C\,R$ and $R = \frac{E}{C}$ in which the current is represented by C, the electromotive force by E and the resistance by R. Thus when two of the quantities are known the other may be easily determined. The current is measured in amperes, the electromotive force in volts and the resistance in ohms.

The applications of this law are found in every use of electricity. A little practice will enable any one to use the formulæ whether they have studied algebra or not. If we want to find the resistance of a 100 volt incandescent lamp using one-half ampere of current we substitute for the letters in the formula $R = \frac{E}{C}$, those quantities, and we have resistance of lamp equals 100 volts divided by $\frac{1}{2}$ ampere, which is 200 ohms, the resistance of the lamp. Often times motors, storage batteries, etc., are to be used on a circuit with greater electro motive force than that for which they were intended. In determining the amount of resistance for securing the correct current Ohm's law helps us out.

Electrical Units in Common Use.

The following are the most common units used in electrical practice:

AMPERE. The unit of current strength. The electric current is measured by amperes as the flow of water in a pipe or ditch is measured in cubic inches. Thus the flow of water is so many cubic inches per second; the electric current is so many amperes per second. The international ampere is represented by the unvarying current that in passing through a specified solution of nitrate of silver deposits silver at the rate of 0.001118 of a gramme per second.

COULOMB. There is also a unit of quantity called the coulomb, which is the amount of electricity transferred at the rate of one ampere in one second. In giving the quantity of water that has passed in five seconds through a pipe in which the rate of flow is 10 cubic inches per second we would say the quantity was 50 cubic inches. In the electrical circuit in which the current strength is 10 amperes the quantity transferred in five seconds would be 50 ampere seconds or coulombs.

OHM. The unit of resistance. It is the resistance that would limit the flow of current under the pressure of one volt to one ampere. A mile of iron wire, .3 inch in diameter, has a resistance of about ten ohms. The international ohm is the resistance offered an unvarying current by a column of mercury at the temperature of melting ice 14,4521 grammes in mass of a constant cross sectional area and of a length of 106.3 centimeters.

VOLTS. The unit of electromotive force or potential difference. The electromotive force that will cause a current of one ampere to pass through a resistance of one ohm is called a volt. The international volt is represented by $\frac{1000}{1434}$ of the electromotive force of the Clark voltaic cell at a temperature of 15 degrees C, and prepared according to the specifications of the British Board of Trade. If we take the analogy of water the resistance of the conductor to the electric current is represented in the friction, joints, turns, etc., of the water pipe. If there was no force back of the water it would remain stationary. If the pipe is fed from a pond on the hillside or a tank at the top of the building the weight of the water gives it a pressure or head which forces it through the pipes as the electromotive force of the current. The amount of water passing through the pipe is limited by the size of pipe, the condition of the interior, joints, etc., representing the ohms resistance of the electrical conductor.

WATT. The unit of electrical power. It is the work represented by one ampere impelled by one volt. It has sometimes been called the ampere-volt. A horse-power is equivalent to 745.9 watts, 746 being commonly used. In rating electrical machinery the kilowatt or 1,000 watts is the common term, abreviated to K. W. and is equal to approximately one and one-third horse-power.

Special Decorative Incandescent Lamps.

The accompanying cuts, Figs. 1 and 2, show two styles of incandescent lamps especially designed for decorative lighting. They are manufactured by the Columbia Incandescent Lamp Co., of St. Louis, Mo. Fig. 1 represents the round bulb coiled filament 16 candle-power lamp which is made for the higher voltages and well-fitted for window decorating and similar places. The filament will not drop when used in a horizontal position and they maintain their candle power to a high degree. Fig. 2 represents a special candelabra lamp for 100 volt circuits and upwards, and makes a very pretty effect when used with colored shades.

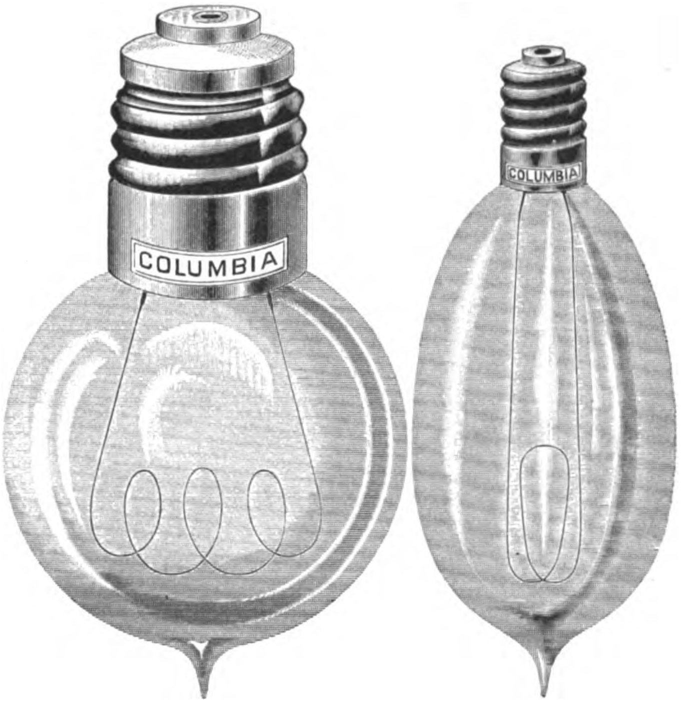


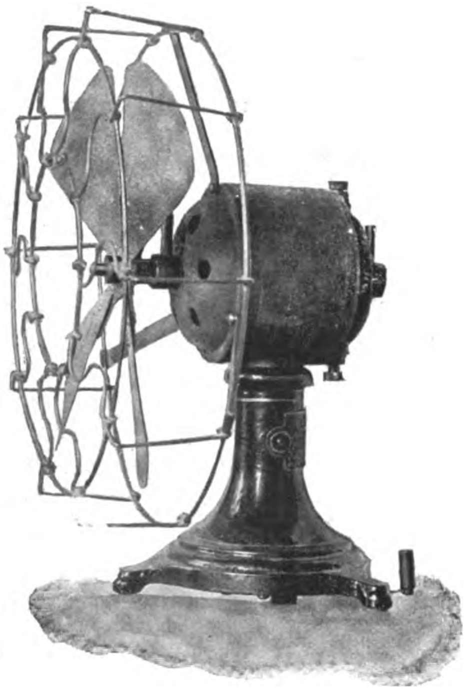
FIG. 1 AND 2.—SPECIAL DECORATIVE INCANDESCENT LAMPS.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

New Riker Fan Motor.

The accompanying cut shows the new fan motor brought out for the season of 1895 by the Riker Electric Motor Co., of 45 York St., Brooklyn, N. Y. A number of improvements have been made in the motor that has met with such favor heretofore which make it still more desirable. Fan motors are almost as necessary a part of the equipment for the summer as any other article and will be in greater demand than ever this season.



NEW RIKER FAN MOTOR.

The motor is enclosed and the fan covered by a wire frame so that no part is liable to injury. It is almost dust proof as near so as sufficient ventilation will permit. Each part is accessible and all parts are interchangeable. The body of the motor is made of cast steel and the base and bearings of cast iron. The form is neat and the motor takes up but little room. The fan is twelve inches in diameter and when driven at a speed of 1,800 revolutions per minute the motor requires but one fourth ampere at 120 volts.

By a lever at the base of the motor the speed is regulated from 900 to 1,800 revolutions per minute. The finish of the motor is as neat as could be desired. It is ornamental in every respect. As to its durability the experience of previous seasons is a sufficient testimony of the skill employed in its construction.

New Electric Lighting Fixture.

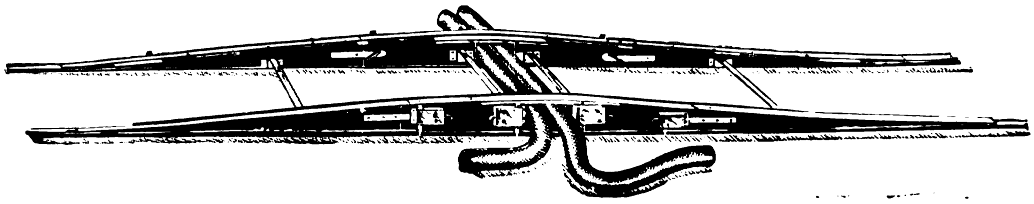
The electrical fixtures designed and manufactured by the W. S. Edwards Mfg. Co., 21 E. Lake St., Chicago, show many unique designs. The accompanying cut shows a pillar light which has but recently been brought out. It is made in the form of a cigar lighter, the gas flame coming from the mouth of the dragon while the top is an ornamental glass bulb in which is an incandescent lamp. The light illuminates the room as well as showing to good advantage the handsome ornamentation of the pedestal. Every detail is wrought by skilled workmen and the design has been beautifully executed. The same fixture is also used as a newel post in places where something large and elegant is desired, by dispensing with the gas flame. It is a most elegant fixture for such a position. The catalogue of the company shows many handsome designs for the great variety of places where electrical fixtures are now used. New designs are constantly appearing as new and original ideas are conceived by the designers who are in the foremost rank of the profession.

NEW LIGHTING FIXTURE.

The company recently completed the lighting fixtures of the new Criminal Court Building for the City of Chicago, among which are some very handsome designs. The electrical fixtures in all parts of the country which have been furnished by this house are sufficient evidence of the excellence of these goods.

Portable Hose Bridge.

The delay, inconvenience and trouble occasioned by a fire to travel on the street railways is well known to all. As soon as a line of hose crosses the track the street car line is blocked, and passengers are either obliged to walk or wait for hours until the blockage is raised. The income of the road is stopped for a time, which may be the busiest time in the day. The confidence of the public in the regularity of the service of the company is also shaken, and the running schedule of the cars is seriously confused.



PORTABLE HOSE BRIDGE.

As a remedy for this, the Metropolitan Electric Co., Chicago, offer to street railway companies the portable hose bridge, illustrated in the accompanying cut. It affords a track for the cars above the lines of hose as shown. The length is sixteen feet, which gives a gradual rise to the track the few inches necessary to cover the hose. It is built in three sections, which are quickly connected by means of patent clasps.

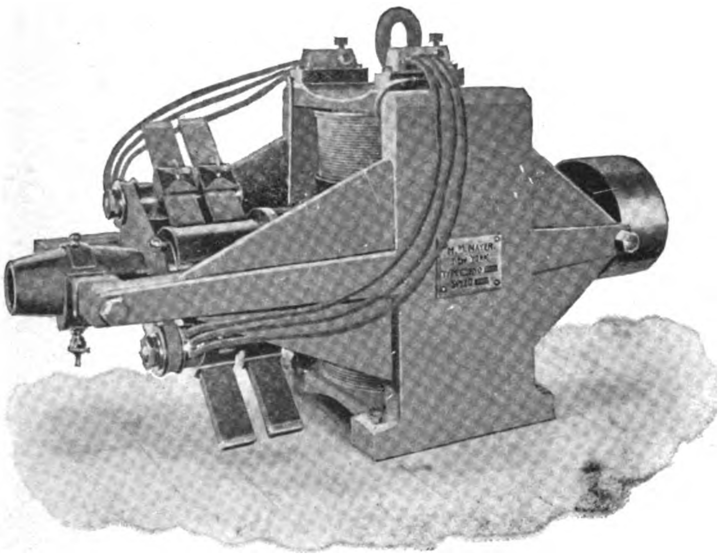
Braces hold the two sides firmly in place, and ratchet spikes hold the parts to the ground and rail. It fits any style of rail, and is made to any gauge of track. It is constructed of heavy material which will support either motor car or trailer. One man can place the bridge in position within three minutes, and it is carried either in a car or on the repair wagon. Each bridge accommodates two lines of the largest fire hose. The ends of the bridge fit to the track so closely that there is scarcely any jar to the car when passing over it.

These bridges are in use on a number of roads, where they are giving good satisfaction. The Metropolitan company has added this important railway appliance to the extensive line of railway supplies now handled.

The Mayer Dynamos and Motors.

The machine illustrated in the accompanying cut shows a compactly assembled dynamo, a skillful arrangement of the different parts and an efficient use of material. It is of two pole type, iron clad, with the pole pieces and frame cast in one piece. The metal used is a grade of steel whose magnetic qualities especially adapt it for this use. The magnetic circuit is short and efficient and so planned that there is little waste, the lines of force being concentrated on the armature.

The armature is of the drum type, laminated to prevent heating of the core and the windings are made in slots in the core. The arrangement is strong and serviceable. The field magnets being shunt wound the voltage of the current is practically constant. The machines are so constructed that they will stand a considerable overload without injury. The mechanical design and construction show a good distribution of metal, a strong and durable machine.



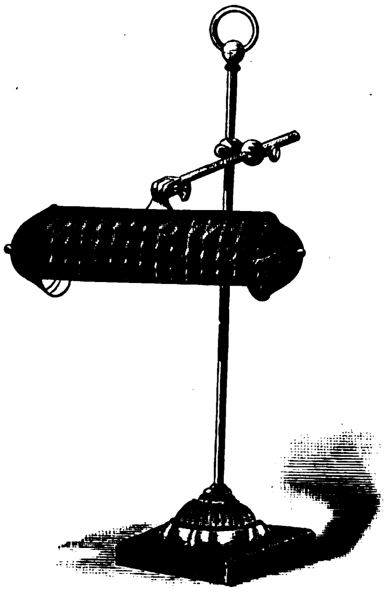
THE MAYER DYNAMOS AND MOTORS.

The shaft is extra heavy. The bearings are phosphor-bronze and are self-oiling. The commutator segments are pure tempered copper, insulated with mica and securely fastened together. The entire machine is very simple and all parts are accessible. Inspection is an easy matter. Before shipment each dynamo or motor is given a thorough testing which determines the excellence of the machine. Should any fault be detected it is returned to the workmen to be corrected. To the thoroughness with which this department is conducted is due the favor which these machines have received from the trade.

It is proposed to erect a memorial to Von Helmholtz. A committee has been formed to receive subscriptions.

The New Klemm Adjustable Shade.

The accompanying cut shows a new shade for incandescent lamps especially adapted for desk or table use. In office or library such a device has become almost a necessity. This stand and shade have but recently been brought out and is designated as No. 236. It is manufactured in connection with a full line of such devices for incandescent lights and gas by Klemm & Co. of Philadelphia, for the American Reflector Co., 132 N. Fifth Street, Philadelphia. The arm carrying the shade can be moved up or down in or out to any position that may be desired. The adjustment is a simple matter that requires but a moment to effect. The shade can also be adjusted to any angle so as to throw the light in the direction desired. The shade gives good results on roll top desks, or on flat top desk. The light can be turned in the direction that will give the best results. The reflector is made of bright metal finished in several colors; the base is strong and the device is well balanced. It occupies little space on the desk and is most effective in any place where it is desired to shade the eyes and throw a good light over a limited area.



KLEMM ADJUSTABLE SHADE.

By means of a flexible cord they are connected with any electrical fixture. Other designs of stands and attachments are adapted to almost all situations, and are modified for lighting pictures, groups of statuary, etc., the reflectors being made of any length and for any number of lights. The proper effect is produced without the lamps being seen. The eyes are protected from the glare of light while at the same time the full benefit of the light is secured.

Brooklyn Bridge Cars Lighted by Electricity.

The cars on the Brooklyn Bridge line are now lighted by electricity. The overhead trolley system of connection is used with the rails for the return current. The current is generated at the Brooklyn Bridge power house. The most noticeable feature of the equipment is the trolley which instead of being of ordinary pattern is like some used in Europe. It is triangular in form, carrying on the horizontal side a brass tube, eighteen inches long, which bears against the trolley wire. The trolley wheel with the short arm would not follow the wire, and on that account this device was adopted.

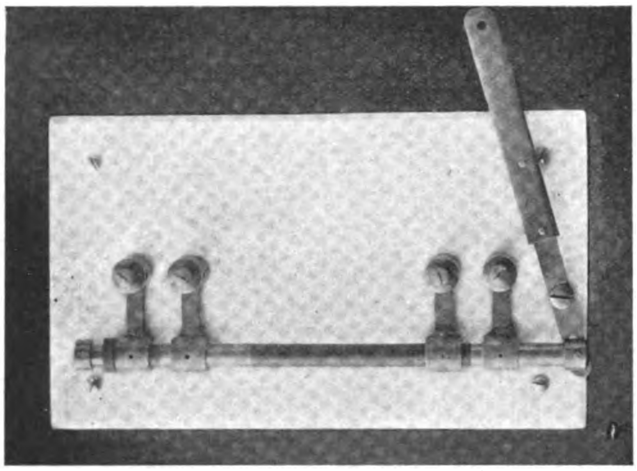
An Electrically Lighted Carriage.

The first private carriage lighted with electric lights in Chicago is that owned by Mr. Geo. A. McKinlock, president of the Central Electric Co. The lights are fed by storage batteries placed under the coachman's seat. Switches on driver's seat control the lights. Electric globes are placed in the lanterns at the side of the carriage and in the center of the ceiling is a group of electric lights in a hemispherical globe. These lights are also controlled by a switch in the upholstered side of the interior of the carriage.

The batteries are five Pumpelly-Sorley 40 ampere hour cells giving about 10 volts pressure. The lamps used are six candle-power ten-volt lamps. It is estimated that the battery will supply current for the lamps for about ten consecutive hours. The interior lights are especially attractive and also very convenient when it is desired to read a paper, consult the time piece which could otherwise be done only as one caught the light of street lamp or of passing shop window. The wiring is entirely concealed and there is nothing in evidence as to the source of light except the lights themselves.

The S. K. C. Arc Lamp Hanger Board.

In the accompanying cut is shown a new arc lamp hanger board which has recently been placed before the trade by the S. K. C. Specialty Co., of Pittsfield, Mass. It is extremely durable and of a substantial construction. The cut-out is absolute and does not spark. It first shunts out the lamp before cutting it out entirely. It is quick and positive in operation. The board is made of electrical slate or marble and is fireproof and ornamental. It fulfills all conditions and will be found most satisfactory by users. The cut shows the details of this new specialty.



THE S. K. C. ARC LAMP HANGER BOARD.

The Strowger Automatic Telephone Exchange System.

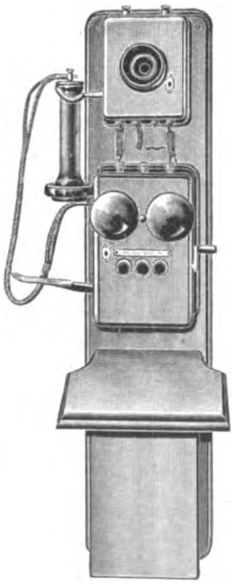


FIG. 1.—STROWGER TELEPHONE.

The first automatic exchange system exhibited by this company a few years ago attracted considerable attention, but when compared with the improved system now offered it was a clumsy affair. The present system is much more compact, every part is open to inspection, although in the complete exchange the whole is enclosed in a cabinet to protect it from dust and it is simple in operation. The telephone instrument is shown in Fig. 1. It has much the same appearance as the Bell instrument, with the exception of the push buttons, by means of which the connections are made at the exchange. The individual buttons represent units, tens, hundreds, etc., one pressure for one hundred, two pressures gives two hundred on the hundreds button, etc. Thus, if the subscriber's number with whom you wished to talk was 341, to make that connection you would press the hundreds button three times, the tens four times and the unit button once. The instrument shown has three buttons, which would allow any subscriber up to 999 being called. This is the regular instrument for a thousand subscriber exchange. When the connection is made you ring the bell on your telephone which at the same time rings the bell of the subscriber with whom you are connected. When through talking the hanging up of the receiver automatically releases the connection. In Fig. 2 is shown the automatic switch by which connection is made at the central exchange. Each subscriber has a switch of this kind at this station. If there were a thousand subscribers there would be a thousand switches of this kind. Below the switch and mounted on the standards are the connections or terminals by which this switch is connected to every other switch. These terminals are mounted in blocks of one hundred. The switch shown has ten of these blocks or one thousand connections. The step by step process is used in the operation of the automatic switch. Mounted on the rod that extends the entire height of the switch are a number of small clips that engage the terminals at the back. These clips are arranged so that they are a certain distance apart on the rod and project at a certain angle from each other. The terminals are arranged in rows of ten in each block. By ten steps or less the rod is raised; by the same number of steps or less is turned and the clip on the rod connects with the proper terminal. It is positive in operation, there is no waiting unless the telephone is busy with whom you wish to talk. When that occurs, instead of the final connection being made, the switch is thrown back to its first position in the same manner as when the receiver is hung up when through talking.

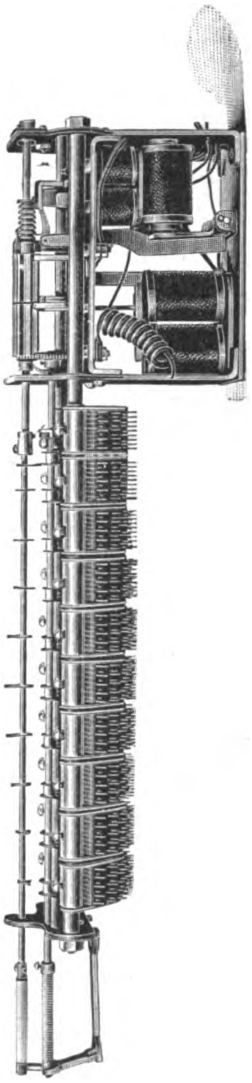


FIG. 2.—AUTOMATIC SWITCH.

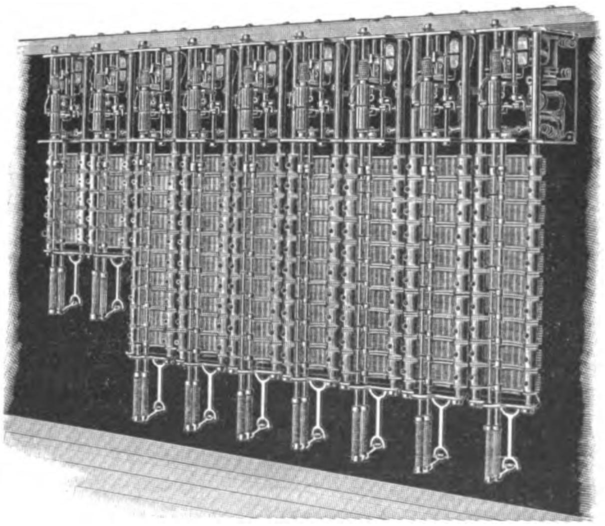


FIG. 3.—THE STROWGER AUTOMATIC TELEPHONE EXCHANGE SYSTEM.

In Fig. 3 are a number of switches. The first two at the left are for 500 subscribers and the others are for 1,000 subscribers. The switches are not large, the cuts here shown being made large in proportion to show as much of the details as possible. The space required for an exchange is very small in comparison to the exchanges with manuel boards. Aside from the saving of expense for operators it has been found an advantage to have the connection entirely under the control of those talking, since there is no interruption. The conversation is not broken by frequent calls—"any answer?"—etc., which are very annoying.

This system is in operation at a number of places for city exchanges, and the testimonies of the subscribers show that they are well pleased witth the system. The main offices of the Strowger Automatic Telephone Exchange are at 947 and 949, the Rookery, Chicago.

Automatic Boiler Feeder, Purifier and Heater.

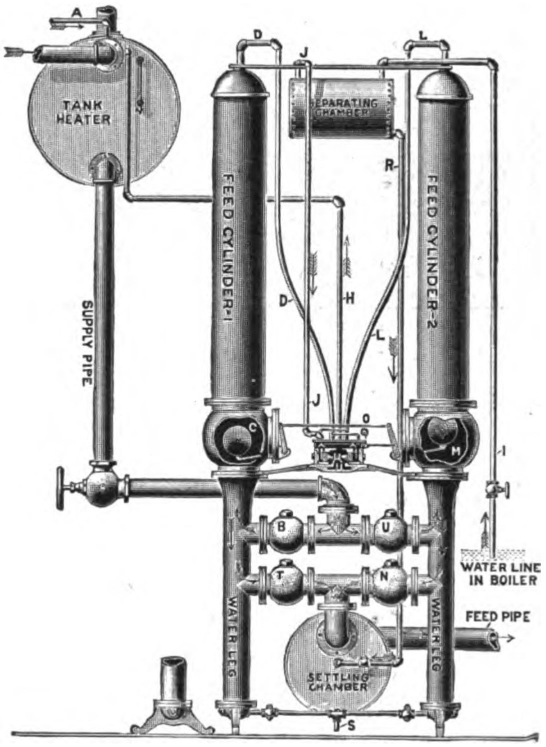
The automatic boiler feeder, purifier and heater illustrated in the accompanying cut is manufactured by the Automatic Boiler Feeder Company of Marion, Ohio.

This machine feeds the boilers without the use of pump or other boiler feeding device, maintains a positive water line in the boilers at all times, prevents scale formation and heats the water with exhaust steam, after which it is superheated as it passes through the feeder and purifying processes.

The water pipe A carries the feed water from source of supply to the heater, where it comes in contact with the exhaust steam and is heated to the highest possible degree without a pressure (from 200 to 212 degrees, owing to the amount of exhaust). The water, after being heated, passes through the supply pipe to the feeder, raising the check valve B and passing upward through the float chamber C into the feed cylinder 1, which, owing to the present position of the valves in the steam chest, has been relieved of its resisting boiler pressure by reason of the steam having been exhausted out through the pipe D into the port E and out under the slide valve F into the exhaust port G and on through the pipe H to the heater. At the same time the feed cylinder 1 is filling as above described, the feed cylinder 2 is supplying the boiler as follows: If the water in the boiler is below the end of the pipe I, steam will pass up through this pipe into the separating chamber and out through the pipe J, into the steam chest, from there into the port K and out through the pipe L to the top of the column of water in feed cylinder 2. The steam pressure on the column of water will then equalize the boiler pressure, which acts as a resisting force. The boiler pressure now being equalized by steam pressure, which also comes direct from the boiler, the water being above the water line will naturally gravitate to its level, passing out through the feed cylinder 2 and float chamber M, and on raising the check valve N, passing through the settling chamber and on into the boiler through the feed pipe. When the feed cylinder 2 has emptied below the float chamber M the feed cylinder 1 will have filled from the heater as before described, and the float in the float chamber C, being now submerged in water, will rise by reason of the overbalancing weight of the float in the chamber M, which has lost its buoyancy by the water having fed out below it. The floats are connected by the connecting rod O and transmit their power through connections to small valves in the upper part of the steam chest, moving them from the left as they now stand to the right, allowing the steam to the right of the piston to exhaust out through the small pipe Q into the pipe D. At the same time, and by the same movement of the floats, the small valve at the left of the steam chest will be open to the live steam pressure, which will pass down to the left of the piston and drive it to the right, moving the valve F, opening the port E to the steam pressure from steam chest, and opening the port K into the exhaust port G, through which the pressure from the feed cylinder 2 and pipe L is exhausted into the heater through the exhaust pipe H.

The feeder holds the water always at the same height in the boiler, by reason of its taking steam through the steam and skimmer pipe I, which extends down to the water line in the boiler, for as the water falls below the pipe I it will admit steam to the feeder, but as it rises again it will close the opening of the pipe I and shut off the supply of steam for the time being, and the feeder then having no power to counteract the resisting boiler pressure will not feed until the water has again lowered enough to admit steam through the pipe I.

The sediment collects in the settling chamber and in the two water legs from which it is blown off. The feeder water is subjected to four various purifying processes: 1 In the heater; 2, as it stands in the feed cylinders above the water legs; 3, as it first passes through the settling chamber before entering the boiler, and, 4, as that sediment which still remains is taken out of the boiler through the skimmer pipe I and deposited in settling chamber. These machines are built in several different styles to suit the work required of them.



AUTOMATIC BOILER FEEDER, PURIFIER AND HEATER.

The generation of electric power by means of gas engines has received considerable attention in Europe and will undoubtedly receive more in this country. The American Gas Engine Electric Co., Chicago, which handles the double acting gas engine manufactured by the American Gas Engine Co. and Messrs. Dick, Kerr & Co., of London, has recently issued a small treatise on the "Gas Engine and Electric Power up to Date."

At the exposition of 1900, at Paris, a special palace is to be erected, to be devoted to electricity, which will be one of the great features of the display.

The Mosher Separator.

We illustrate herewith the Mosher patent steam separator for separating all moisture from steam. The practical man will understand at a glance the principle of operation which is the utilization of centrifugal force, illustrated in the accompanying cuts. The other important feature, and one which is found in this separator, is that of at once isolating all water of separation from the current of steam, thereby rendering it impossible for any water to be again picked up and carried over to the engine. An examination of the drawings will show that the construction of the Mosher separator is extremely simple. As will be seen the steam conduit consists of a slightly enlarged section of the main steam pipe in which is located a worm or twisted plate. The wall of this conduit is of spiral form with one lip below the other, as is shown by the cross section cut, thus forming a slot through which all moisture is thrown to the collecting chamber below. Thus the steam is acted upon many times in its passage around the twisted plate and the heavier particles being thrown outwardly by centrifugal force are shaved off and deposited in the isolated chamber below, from which it may be returned to the boiler.

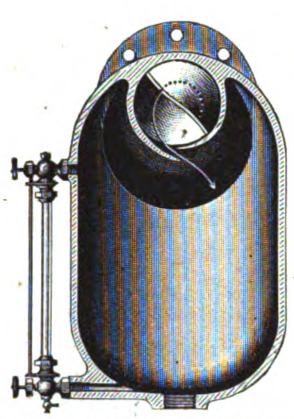


FIG. 1.—MOSHER SEPARATOR.

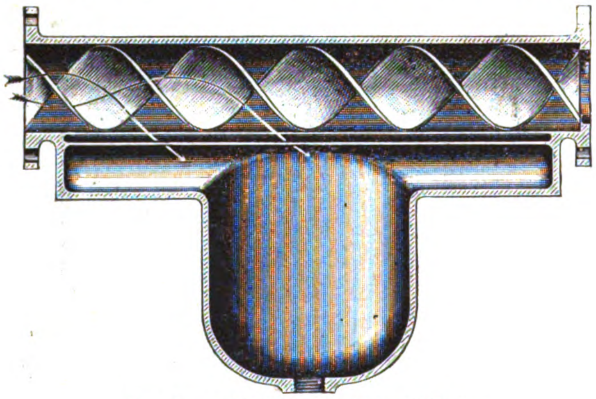


FIG. 2.—THE MOSHER SEPARATOR.

The Mosher steam separator is also made with small collecting chamber, rendering it more compact and adapted to places where other styles would be excluded on account of limited space. This style is peculiarly adapted to many other uses, among which is the extraction of oil from exhaust steam rendering a considerable saving in oil and in destruction of roofs, on exhaust pipe, when steam is used for heating purposes, to keep pipes and radiators from becoming clogged with oil and rendering them inefficient; between cylinders of compound engines to extract water or condensation; between low pressure cylinder and condenser to avoid the clogging up of the condenser by oil from cylinders.

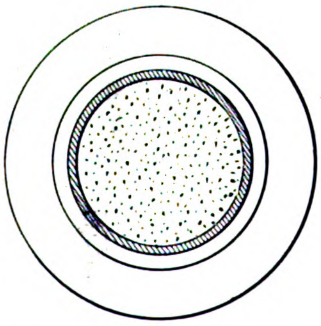


FIG. 3.—ILLUSTRATES THE PARTICLES OF WATER AND OIL IN THE STEAM.

The Mosher special ammonia separator for use in ice and refrigeration plants to extract the oil from ammonia gas, thus providing against the pipes becoming coated on the inside by oil in cylinder lubrication, which renders them very inefficient, is worthy of notice. In the last named capacity the Mosher separator has successfully accomplished this extremely difficult problem of separation. Many boilers are subject to violent priming or foaming, during which a considerable amount of water is carried out of the boiler. In such cases the trouble may be entirely avoided by the introduction of a Mosher separator inside the boiler, as shown in Fig. 5. The separator, which by reason of its small size may be introduced through the ordinary manhole and connected between throttle and a perforated dry pipe, will prevent any wet steam leaving the boiler due to primage and therefore furnish dry steam at all times regardless of how severe the boiler may foam prime.

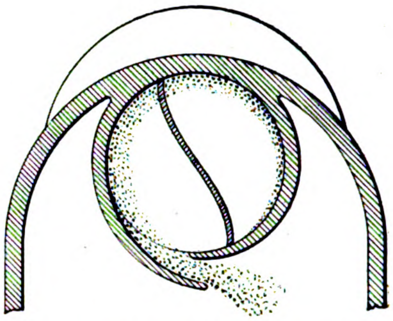


FIG. 4.—ILLUSTRATES METHOD OF SEPARATING OIL AND WATER AND THEIR EXPULSION FROM STEAM.

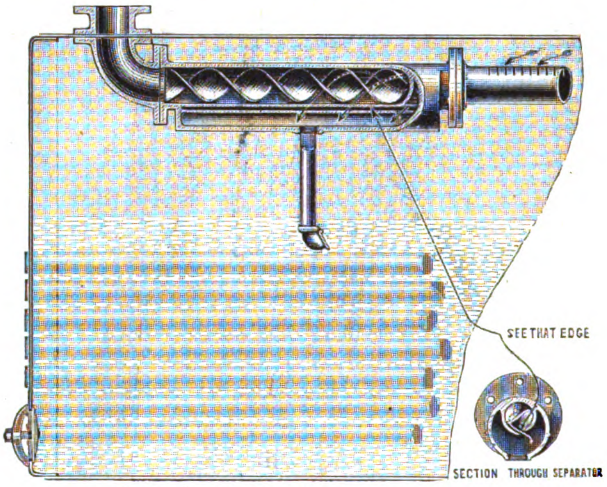


FIG. 4.—THE MOSHER SEPARATOR.

The Mosher separator is built in sizes from one and one half inches to any size required. The larger sizes will be constructed of steel castings or boiler plate when so desired and to withstand any desired pressure. For ordinary use the separators are tested for two hundred pounds working pressure per square inch. These separators are built by Charles D. Mosher, No. 1 Broadway, New York.

The Factory of Crocker-Wheeler Co. Destroyed.

On Sunday, April 7, the factory of the Crocker-Wheeler Electric Co., at Ampere, N. J., was destroyed by fire. The office and pattern shop were uninjured. The buildings were burning briskly when the East Orange fire department arrived. The fire was discovered by the watchman, but his efforts to extinguish it were futile. A large amount of costly machinery, the equipment of the factory and the machines and apparatus being manufactured were destroyed The loss is covered by insurance. Five hundred or more hands were thrown out of employment temporarily. An effort was made immediately to secure temporary quarters where the business can be conducted until the factory is rebuilt.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay. and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—ED.]

SOLDERING FUSE LINKS.

Till the insurance inspector came around the other day, I have used fuse wire instead of links in all blocks and have had no trouble, as I have been very careful about putting them in. I have changed all fuses since his nibs was around. A good many of the fuse links have blown since I made the change and I have on hand a considerable number of the copper ends. I wish some one would tell me through this column how they solder the links. I have never had occasion to do it heretofore. I may be able to return the favor on some subject with which I am better posted. SOLDER.

ELECTRIC STREET CAR FENDERS.

Are the fenders now in use any protection? is a question I should like to see discussed by railway employes. The public has had its say in the newspapers, and fenders are required by law on many of the roads. I have never had an accident, but I can't say when my day may come. After running three years without a fender I found my car as I started out one morning about three months ago with a big scoop hitched on the front of it. I went along as usual until I came to a corner where the scoop swept out at the side, just missing a coal wagon on the other track. I wasn't prepared for the long reach the fender had, and as my eyes were watching several other things I just avoided a pickup; but I doubt if the thing would pick up anything. When teams pass in front of the car they don't seem to notice the fender,and a number of times they have just missed it. The length of the car is increased and so much more is placed on the responsibility of the motorman. It may be possible to build a fender that would pick up a person should the car strike him, but all I have seen described in papers and circulars don't seem to be of much good. They will crush a person, and if they don't break any bones they will bruise him terribly by rolling him over and over on the pavement. It is an easy matter for anyone to stand up in front of a car and throw themselves on the fender, but that is not the way you strike persons in the street. They come unexpectedly in front of the car, and as they realize the car is upon them they endeavor to throw themselves out of the way, and instead fall in front of the car. M. P.

A LITTLE OUT OF THE JUG.

Having been connected for over twenty years with power plants I have naturally seen a good many accidents of one kind or another. Since electric power began to be used I have been connected with such plants and accidents have not decreased in number. Our boilers have never blown up nor our station burned down, but some one is using his fingers for a short circuit or the fuse blows out before he gets his fingers off, or the fireman gets hot water down his boot, or something of the kind. So many such accidents have occurred that I always keep some remedies around the station. I keep a jug of lime water and linseed oil, half and half, always on hand, which is the best thing I know of for burns. The boys don't forget it, and I frequently hear some one say: "Bill, let me have a little out of the jug." I keep a few cotton bandages rolled up, because I don't know what might happen. No matter how bad the burn is I pour "a little out of the jug" over it and tie it up. It keeps the air away and cools the smart and pain of the burn. Fortunately on several occasions my medicine has done the business as well as the best physician. BILL.

LINING UP THE DYNAMO.

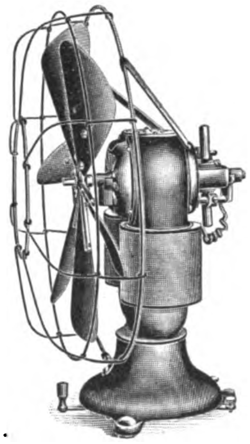
I got in a new multipolar generator the other day that is out of sight. One of the old machines had been giving us trouble for some time, but we could not get time to overhaul it, so when we got this one in we had to put her to work as soon as the expert got through with her. He lined her up; the belt was put on, and then turned her over slowly to dry out the armature. When I started her up the next day to help out on the load she ran about two minutes and off went the belt. To say I was mad is to but half express it, but I did not know which to blame, the expert or the man who put on the belt, or both. When I got time to investigate matters I found the dynamo out of line. The expert had the bed plate fastened down with lag screws, so it was as he left it. What I would like to know is how that expert lined up the machines. Nobody saw him do it. The fireman thinks he did it with a squint of his eye, and perhaps he is right. ENGINEER.

THE BOOSTER AND EQUALIZER.

Will someone please give an explanation through these columns of the booster used on the Westinghouse 4,000 light alternator? I use them every day, but don't understand them nor why only one side of the circuit is run through the booster, the other side having direct connection with the machine. How can it be induction current? It seems to me that the side going through the booster would have much stronger waves than the one leading direct from the machine. And also explain how the equalizer or third wire equalizes the load in running two generators, and oblige J. F., Pittsburg.

The R. & E. Electric Fan Motor.

The R. & E. electric fan motor illlustrated in the accompanying cut shows many improvements over former patterns. The commutator and brush holders have received special attention, and the motor has been made more durable and efficient. The bearings are self-oiling, a feature most desirable. The armature is of the gramme ring type, so proportioned as to give a maximum efficiency. The commutator is made of a special hard metal, carefully insulated with mica and giving a large contact surface. The speed can be varied and the fan is protected by a neat wire guard. The motor runs noiselessly and is neatly finished. These fan motors are made by Roth Bros. & Co., Chicago, who have an established reputation as builders of dynamos and motors. Their machines are shipped to all parts of this country and also to foreign countries.



R. & E. FAN MOTOR.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

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51. *For what purposes are static machines used other than for gas lightiny?*

They are used largely for medical and educational purposes. Many important investigations in connection with lightning arresters and in other lines have been carried on with the help of static machines in laboratories connected with electrical manufactories and colleges.

52. *Is the electricity on belts caused by friction?*

It seems to be caused partly by the internal friction when the belt bends around the pulley. It is largely caused by friction between the air and the belt. Most of the electricity is taken off through the pulleys and shafting.

53. *Why does the belt give more electricity on some days than on others?*

When the air is moist it is not so good an insulator. The belt also becomes more or less damp and allows the electricity to pass along to the pulley and escape.

54. *How can a person tell whether a belt is charged with electricity?*

A spark or bluish colored brush will pass from the belt to one's hand or to any piece of metal held near, if the belt is charged. If one stands near a belt that is highly charged, the electricity will cause his hair to stand out and he will feel a peculiar sensation as if he had brushed against cobwebs.

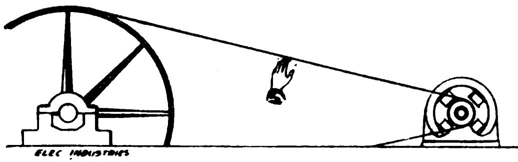


FIG. 8.

55. *Is the electricity from a belt dangerous?*

One may sometimes obtain an uncomfortable shock but it is not considered dangerous to persons. It may cause trouble to electrical dynamos and motors.

56. *Why is the belt electricity dangerous for dynamos and motors?*

Because it sometimes jumps through the insulation, causing a spark. The regular current from the machine is not ordinarily of high enough pressure to jump through insulation, but it can follow a spark. Sometimes the static electricity from the belt charges the iron frame of the machine, jumps through the insulation to the wires and so "grounds" the machine. On arc light or alternating current machines using high potentials, this makes it dangerous to touch even the frame when the machine is running. Under some circumstances this may cause the machine to become short circuited and so burn out.

57. *Is electricity from belts liable to cause fires?*

A number of cases are known where fires were started in this way. The sparks have set fire to the vapors of benzine or gasoline used for cleaning type in printing offices or for cleaning clothes in tailor shops. Such sparks might also set fire to oily waste or other inflammable material.

58. *Are fires caused by frictional electricity other than that from belts?*

Several fires have occurred in dressmaking establishments from sparks caused by friction when cleaning dresses with benzine.

61. *How can electricity be removed from belts?*

A common method is to fasten near the belt a number of sharp metallic points which are connected with the ground. One way of doing this is to drive a number of sharp tacks through a piece of tin, or to solder some small wires to a large one, and to fasten the row of points near the pulley so as to be within an inch of the belt. Another method is to stretch a wire lengthwise of the belt and a few inches above it. Still another plan is to fasten a bundle of fine wires, such as are used in lamp cord, a short distance above the belt. Any of these devices will take most of the electricity from the belt, if electrically connected with the ground and if the points are close enough to the belt. Of course care must be taken that they do not become caught in the belt.

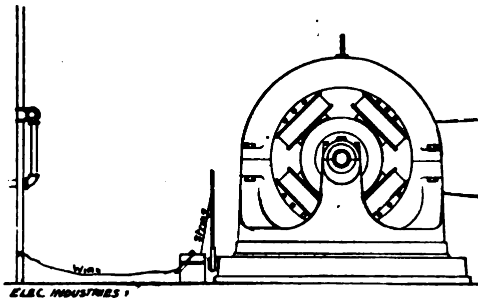


FIG. 9.

59. *What causes the peculiar smell like wet matches that is often noticed near belts that are charged with static electricity?*

The smell is the ozone that is formed from the oxygen of the air by the electric spark.

60. *Is this smell dangerous or poisonous?*

It is not poisonous, but healthy. It is believed to be a source of danger since oily waste and similar substances will ignite spontaneously more easily if much ozone is present. Fires once started will spread faster when the air contains ozone.

61. *What methods are used for taking the static electricity away from shafting and machines?*

The best way is to connect the hangers or some other stationary point by means of a wire fastened to a water, gas or steam pipe, or to a rod driven into damp earth.

62. *Is this method used with dynamos and motors?*

Not generally. The frames of such machines are usually insulated from the ground so as to reduce the danger of the circuits getting "grounded" and so allowing the current to escape or cause damage.

63. *How may the static electricity be removed from dynamos or motors without grounding them?*

The static electricity is of so high pressure that it will travel over paths that are good insulators for the regular current. Such a path is furnished by a moistened string, a pencil mark or a piece of paper, or a can of pure water. Place a can of water on the floor under or near the machine, connect it to a water or gas pipe by means of a small wire, tie a string to some convenient part of the machine, and let the end of the string dip into the water. The string will soon become moist enough to carry off the static charge without grounding the machine, Fig. 9. A neater and cleaner way is to make a long mark with a common lead pencil upon a narrow strip of paper; fasten one end of this under the head of a bolt or other convenient place so that one end of the pencil mark touches the machine; a small wire attachedto a good ground may be connected with the other end of the pencil mark by means of a washer andscrew.

64. *Why do some belts give more electricity than others?*

Rubber belts are usually more highly charged than leather belts because they do not take up moisture and are better insulators.

New Multipolar Dynamo of the Ft. Wayne Electric Corporation.

In the accompanying illustration, Fig. 1, is shown the new multipolar dynamo recently brought out by the Ft. Wayne Electric Corporation. The machine shown is a medium speed dynamo of 60 kilowatts' capacity, and designed for incandescent lighting. The machine presents the same neatness of outline and substantial appearance that is noticeable in the other lines of electrical apparatus designed by Mr. James J. Wood, the electrical and mechanical engineer of the Ft. Wayne corporation. This type of machine is now built in all sizes, from 25 to 800 kilowatts' capacity.

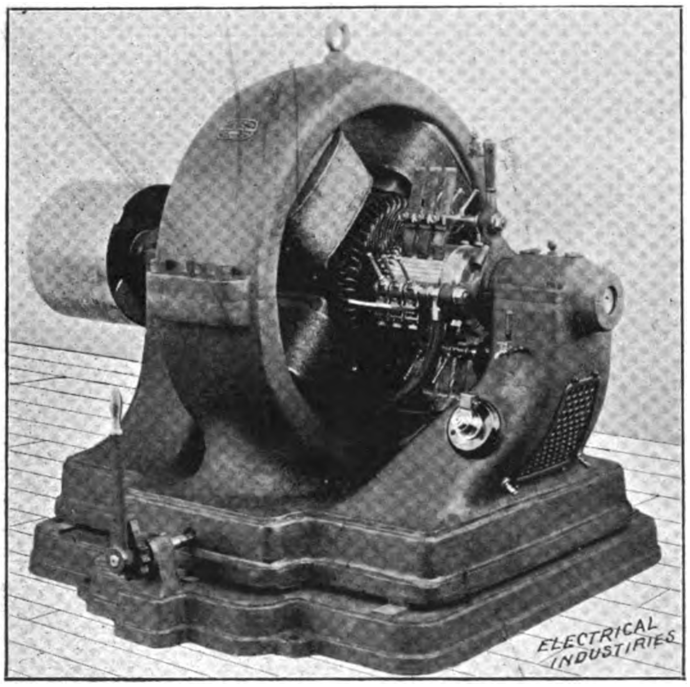


FIG. 1.—NEW MULTIPOLAR DYNAMO OF THE FT. WAYNE ELECTRIC CORPORATION.

In sizes up to 120 kilowatts the lower portion of the field, pedestal and base are made in a single casting, while in the larger sizes the parts are cast separately to permit the machine to be assembled more easily. One of the noticeable features of this generator is the absence of all loose wires and cables. The connections are made by removing the perforated doors where they connect with the main binding posts, which are mounted on slate bases. The two small binding posts shown in front are for the field rheostat connections.

The dynamo is compound wound and can be run in either direction by simply reversing the brush-holders on the studs and without changing any of the other connections, the brush-holders being so proportioned with relation to the commutator that the act of reversing them on the studs changes the point of contact 90 degrees, leaving them in the correct position for commutation when the dynamo is run in the opposite direction. The curved pedestal on the commutator end is also a decided advantage, as it not only reduces the floor space and weight of metal required in the base, but enables the dynamo to be turned end for end on the sub-base, should it be required to belt from either end. The bearings are self-oiling and aligning and are of ample proportion to withstand the strains to which they are subjected, while the field coils are wound on steel spools with brass heads, making them very easy to replace in case of an accident.

The construction of the armature of this dynamo exhibits several novel features. Fig. 2 shows the commutator and core complete, with one of the coils in place. The armature core is constructed from segmental punchings, having hooks projecting from the inner edge, which partly encloses the clamping bolts. These punchings alternate with one another in order to break joints, the hooks making contact with the bolts of opposite sides, but without completing the magnetic circuit around them. It will be seen from this construction that the several segments are self-supporting, there being no strain on the spider or bolts other than that produced by the torque. As a consequence the spider can be of exceedingly small cross-section. This method of construction greatly increases the radiating surface. The armature is of a minimum weight and the construction is by this method of mounting simplified.

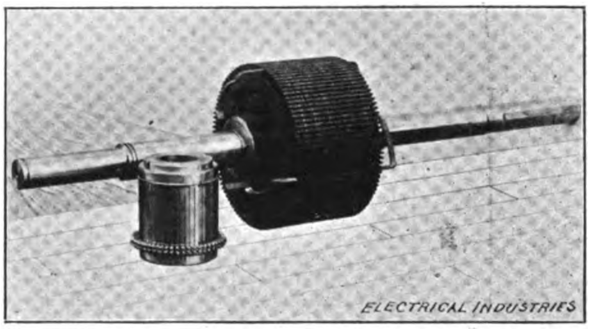


FIG. 2.—NEW MULTIPOLAR DYNAMO OF THE FT. WAYNE ELECTRIC CORPORATION.

The windings of the armature consist of four bare wires wound on a form with a heavy copper connector soldered at one end which makes connection by screws to the commutator segment. There is but one soldered joint in each coil in place of several liable to come unsoldered in the usual methods. The resistance of the winding is reduced, and the radiating surface increased by this method. The windings are so arranged that either two or four brushes may be used. The commutator as shown in Fig. 2, is constructed from hard drawn copper with mica insulation, and is put together by hydraulic pressure. Recent tests of this machine run on a load of 525 amperes at 120 volts for ten hours, show the highest temperature of any part but 35 degrees C. above the room. The weight of dynamo is 7,300 pounds, and of the armature alone but 950 pounds. The speed is 650 revolutions per minute giving an output of 500 amperes at 120 volts.

ELECTRIC LIGHT AND POWER.

EXTENSIONS AND IMPROVEMENTS.

Jackson, O.—The Municipal plant at Jackson, O., will increase its equipment this season. Mr. M. D. Jones is chairman of the lighting committee.

Holland, Mich.—The city has authorized the issue of bonds to the amount of $18,000. $6,000 are to be used in constructing additions to the present water works, and the balance $12,000 is to be used in increasing the capacity of the present electric plant to about 1,500 lights. Mr. W. J. Trott is superintendent of the plant.

Valdosta, Ga.—The Valdosta Electric Light & Power Co. wishes to install a new engine and steam appliances. Mr. B. W. Bently is purchasing agent.

South Hampton, N. Y.—The South Hampton Electric Light Co., will purchase a 1,000 light dynamo and hopes to begin furnishing current by June first. Mr. W. M. Howell is president and purchasing agent.

Goshen, Ind.—The Municipal plant it is expected will be enlarged by the addition of a 60 light arc machine. C. S. Dill is manager.

Wilkesbarre, Pa.—The Wilkesbarre Electric Light Co. is considering number of improvements which include boilers, engines and dynamos, also pole lines and accessory equipments. Isaac Long is president.

Fairbury, Neb.—The Fairbury Electric Light & Power Co. expects to rebuild their station this season. Mr. H. E. Chubbeck is president.

Salisbury, Mo.—The Municipal plant will be enlarged by the addition of one 1,000 light alternators, an engine, and considerable accessories. The commissioners wish to exchange the present engine for a larger one. The city commissioners are: Jno. Clark, D. R Patterson and J. W. Lack.

Old Orchard, Me.—The Old Orchard Electric Co. expects to add to the present plant an engine, boiler and arc dynamo to give them 40 or 50 more arc lamps. W. J. C. Milliken is purchasing agent.

Georgetown, Ky.—The Water Supply Co. will add 1,300 alternating incandescents to the present plant and a dynamo of that capacity. M. T. H. Wolfe is superintendent and purchasing agent.

Cambridge City, Ind.—The Cambridge City Electric Light Co. will extend their lighting circuits to Milton and Dublin.

Colorado Springs, Col. — The Colorado Springs Rapid Transit Co. is extending its lines one and one-half miles, building tracks and trolley lines. D. L. Macaffree is purchasing agent and superintendent.

The Remedy For Boiler Incrustation.

No subject has received more attention from scientific and industrial societies and periodicals than that of the care of boilers and the prevention of the formation of scale on their interiors. The necessity of keeping the boilers free of scale is generally understood. The evil effects arising where the scale is allowed to accumulate, such as the increased amount of fuel demanded, the decreased capacity of the boiler, the deterioration of the plates and the imminent danger of explosions when the plates have become thin have all been discussed. The question of a remedy comes up to every boiler owner at least once and to many it is never settled. The many so-called remedies on the market, some good, others bad and others worse, often confuse the steam user and prevent his using the good judgment that generally accompanies his acts.

Boiler compounds have become almost as numerous as the boilers in which they are used. The extravagant claims that are made for some of them are sufficient to arouse suspicion as to their efficiency. Many are put forth by persons ignorant of the first principles of chemistry and the compounds, while possibly removing the scale, corrode the boiler plates. Thus while preventing one evil, cause a greater.

To be brief, if we carefully subject the claims advanced for the thousand and one boiler compounds now in the market to careful analysis we find our confidence in their efficiency so completely annihilated that we are impelled to advise steam users to let them severely alone or resort to mechanical aids for the removal of scale. There are fortunately, however, more than thirty thousand establishments who have found by actual experience that out of all the materials sold as boiler compounds, there is one at least to which they can permanently "pin their faith,'" and no doubt many of our readers know Lord's boiler compound, manufactured exclusively by George W. Lord, of 316 Union street, Philadelphia.

Lord's Compound will protect a boiler from oxidation and all forms of corrosion, such as grooving, pitting, honeycombing, etc., which are the cause of so many boiler explosions, and it is guaranteed, under a sworn chemist's certificate, to be free from all deleterious substances having any harmful action on the boiler material. It is free from caustic alkalies, which mixed with vegetable acids, form nine-tenths of the nostrums on the market.

The chemical action of this compound is thoroughly basic in nature. It is exclusively composed of soluble chemical bases, which decompose and disintegrate boiler scale by appropriating the acids of the scale forming salts, etc., thus reducing these compound salts into simple rotted oxides, destroying their crystalline character, physical properties and capacity to solidify. As this compound is free from all volatile constituents and will neither contaminate the steam with odor, flavor nor color, it is invaluable to brewers and similar manufacturing enterprises requiring pure live steam.

The steam user has but to send to Mr. Lord a sample of his boiler scale (the size of a nickel), on which the compound is to act and an analysis of the same enables Mr. Lord to furnish a compound exactly suited to the requirements of the individual steam user.

The extensive adoption of Lord's Boiler Compound and the world wide reputation it has achieved during the many years it has been in use, has led unscrupulous parties to endeavor to force worthless imitations upon steam users, even going so far as to make use of the words "Lord's Boiler Compound," "Lord's Patent Improved," etc. There is but one genuine Lord's Boiler Compound, and that is manufactured only by Geo. W. Lord, 316 Union street, Philadelphia, Pa., and is in powdered form, put up in barrels 350 to 450, and casks 500, 600 and 700 pounds each, and half barrels 160 to 200 pounds each.

Recent Sales.

The Chas. E. Gregory Co. reports the demand for lighting and power apparatus exceedingly brisk, and have recently sold apparatus as follows: P. D. Armour & Co., Chicago, 30 K. W., T. & H. alternator; 40 K. W. Westinghouse alternator; Armcur Glue Works, Chicago, 50 H. P., C. & C. motor, 500 volts; Jones Foundry Co., Chicago, 15 H. P., 500 volt T. & H. motor; Marks Mfg. Co., Chicago, 15 H. P., 500 volt, T. & H. motor; Hatch Cutlery Co., Buchanon, Mich., 15 H. P., 500 volt motor; Cheapeake & Ohio R. R., Richmond, Va., 25.K. W. Edison generator; Wm. Wilson, Shell Rock, Ia., 25 K. W. Edison generator; A. C. Parno, Greene, Ia., 30 K. W. Jenny generator; American Glucose Co., Peoria, Ill., 45 K. W. Mather generator; Crane Elevator Co., Chicago, 10 H. P. motor; Lyon & Healy, Chicago, 10 H. P., 110 volt, Detroit motor; Bullock Mfg. Co., Chicago, 10 H. P., 500 volt, T. & H. motor; Chas. F. Elms Engraving Co., Chicago, 8 K. W. Bain generator; Wilson & Jackson, Chicago, 20 Lt. Sperry arc dynamo; Chicago Fire & Spring Co., Chicago, 20-Lt. Sperry arc dynamo; Cicero Elec. Lt. & Power Co., Chicago, 80-Lt. Wood arc dynamo; Chesapeake & Ohio R. R., Covington, Ky., 40-Lt Western Elec. arc dynamo; Henry Electric Co., Henry, Ill., 40-Lt. Western Elec. arc dynamo; Englehardt & Stott Co., Chicago, 5 H. P., D. & D. 500 volt motor; Maltby & Wallace Co., Champaign, Ill., 30 H.P. 500 volt, U. S. motor; Bloomington Elec. Light Co., Bloomington, Ill,, 10 H. P., 500 volt, T. & H. motor; Ela Mfg. Co., Bloomington, Ill., 7½ H. P., T. & H. 500 motor; Penna. & Ohio Coal Co., Duluth, Minn., 30 K. W., H. I., T. & H. generator; A. V. Rusing & Co., Aurora, Ill., 3 H. P., 500 volt, Bain motor; Rossiter & MacGovern, New York, 3 K. W. Edison generator; Alfred Earl, Mich. City, Ind., 3 H. P., 500 volt, T. & H. motor; Wm. Hamberger, Sycamore, Ill., 2 H. P., 110 volt, Westinghouse motor; Abe Bloch & Co., Crute, Ohio, 25-Lt. Compound, Westingham generator, and a total sale of 21 power motors of less than 2 H. P. capacity.

The Walker Manufacturing Co., Cleveland, Ohio, report the following sales in their electrical department, from April 1st to 18th: St. Charles Street Railroad Co., New Orleans, La., three 200 K. W. generators; Corning & Painted Post Street Railway Co., Corning, N. Y., two 125 K W. generators; Messrs. Channon & Wheeler, Quincy, Ill., one 75 K. W. generator; Manhattan Beach Hotel & Land Co., 192 Broadway, New York City, one 60 K. W. lighting generator; Norfolk & Ocean View Railroad Co., Norfolk, Va., two 250 K. W. generators. five car equipments; E. A. Darling, Supt. Columbia College, New York City, one 50 K. W. lighting generator; Messrs. Stern & Silverman, Philadelphia, Pa., for Rapid Railway Co., Detroit, Mich., two 200 K. W. generators, eight car equipments; Dunkirk & Fredonia Railroad Co., Fredonia, N. Y., one car equipment; Scheneley Park & Highlands Railway Co., Pittsburgh, Pa., three car equipments; Buffalo, Kenmore & Tonawanda Elec. R'y. Co.. Buffalo, N. Y., two car equipments; Philadelphia Construction Co., Philadelphia, Pa., for Schulykill Electric Railway Co., Pottsville, Pa., twelve car equipments; Missouri Railroad Co., St. Louis, Mo., six complete car equipments, sixty type B2 controllers, thirty rheostats; Athol & Orange Electric Railway Co., Orange, Mass., two car equipments, one 25 H. P. steel motor; Richmond Railway & Electric Co., Richmond, Va., one 200 K. W. generator, and Frank Spangler Miller, Cleveland, Ohio, for Portsmouth Street & Light Co., Portsmouth, Ohio, two car equipments.

FINANCIAL.

The business of the past month gives evidence of a return in the near future of better prices. The spirit with which other lines of commodities have been taken hold of would seem to indicate that electrical goods could not be far behind. The trade for the month is reported good. Several companies, however, for reasons not connected with the present business conditions, have passed into receivers' hands.

The reported combination of the General and Westinghouse companies has not been confirmed. Some opinions have been expressed by outsiders to the effect that there was nothing in it more than a scheme of sending up the price of the stocks others, however, believe that some arrangement will be arrived at regarding patents.

The annual election of the directors of the Joseph Dixon Crucible Co., Jersey City, N. J., resulted in the following list of directors for the coming year, Messrs. E. F. C. Young, John A. Walker, Daniel T. Hoag, Richard Butler, William Murray, Alex. T. McGill and Jerome D. Gillett. The officers elected at the first meeting of the directors were: President, Mr. E. F. C. Young; John A. Walker, vice pres. and treasurer and Geo. E. Long, secretary.

NEW BOOKS.

Practical directions for Electric Gas Lighting and Bell Fitting for Amateurs. By Edward Trevert. Illustrated new revised edition, 1895, Lynn, Mass. Bubier Pub. Co. 65 pages, paper; price, 25 cents.

Electric bells, batteries, signal systems and electric gas lighting are described in an elementary manner. It is sufficiently clear to enable anyone with a few tools and the necessary material to install the systems described. The illustrations, diagrams, etc., show the methods of wiring and the relative position of the different pieces of apparatus in the system.

A Sound Currency and Banking System; How it may be Secured. By Allen Ripley Foote, author of the "Law of Incorporated Companies Operating under Municipal Franchises," etc. Forming one of the "Questions of the Day" Series, 1895. New York: G. P. Putman's Sons. 110 pages bound in cloth; price, 75c.

The author endeavors to show the necessity of placing the monetary affairs of the nation in the hands of a non-partisan monetary commission. The commission should be composed of honorable men who should be moved by the same patriotism in bequeathing to posterity, a sound currency and banking system, that moved the signers of the Declaration of Independence to bequeath to their posterity a government of liberty. A review of the banking systems of the United States is made and the failure of the United States treasury as a banking institution is shown. The author advocates the gold standard for our currency and the redemption of the silver coin in gold or a pledge to do so.

TRADE PUBLICATIONS.

"Cutter's Street Lighting Specialties" is the title of a very neatly gotten up pamphlet by George Cutter of The Rookery, Chicago. Those specialties which have proved so successful in practice, that they are now considered standard articles, are listed. For central station men it contains a good many suggestions. They may be had on application.

The new catalogue No. 11, of the Ferracute Machine Co. of Bridgeton, N. J., presents the subject of presses and dies. The machines of numerous sizes and styles are illustrated by well executed half-tone engravings and are described in the accompanying notes and tables. Prices are also given. The catalogue is closely arranged and made up in a compact form.

Deutsche Industrie supercedes the Holzarbeiter and the Metall und Eisen-Zeitung. The first number appeared last month. The publication is devoted to various industries in which the Germans are largely engaged in the United States and to trade life in general. It is printed entirely in the German language and the first number makes a very creditable showing. The publishers are Eugene A. Sittig & Son, Chicago.

A catalogue of files, most complete in every respect has been issued by the Nicholson File Co., of Providence, R. I. Files of all shapes and sizes; long and slim; short and stout; flat or round; for any purpose or for every purpose are found therein. To the uninitiated the contents is a revelation in files. There are also scattered through the pages views of the works where these files are made which add much to the attractiveness of the book.

Helios by the Heine Safety Boiler Co., St. Louis, Mo., is one of the most complete books recently issued of boilers and the generation of steam. The contents are not confined to steam alone but include also much valuable information concerning the metals and their production, which are used in the manufacture of the modern boiler. A part of the contents is contributed by well-known authorities on the particular subjects and the matter is very reliable. The volume is a book of instruction, valuable for reference and will undoubtedly occupy a prominent place in the library of power users and engineers. Heat, combustion, various fuels, steam production, etc., are subjects concerning which it is necessary for every one to possess some knowledge. A number of most prominent power plants are illustrated, showing the battery of Heine boilers in use. The views have been well selected and are interesting. The volume contains about 200 pages and is well bound in cloth.

A recent pamphlet issued by the Siemens & Halske Electric Co. of America, Monadnock Blk., Chicago, describes a universal system for the distribution of light and power from the same conductors. It explains the important advantages of the system proposed which is a continuous current, constant potential system from which arc or incandescent lights may be used and motors, stationary or railway, may be operated. The circulars are sent to persons interested on application.

A very handsome little pamphlet discribing telephones has been sent out by the Universal Telephone Company of Indianapolis, Ind. The design is especially neat and tasty. The use of two colors of ink has made the pages especially pleasing to the eye. The details and special features of construction are described and the different styles and types of telephones are illustrated. These include telephones for offices, factories, short lines and long lines, for isolated use or for exchange service.

The new catalogue for 1895 issued by the Partrick & Carter Co., of Philadelphia, contains a most complete list of house goods and general electrical supplies. It is durably bound with cloth back and flexible covers and is business-like in every feature. The methods which have proved the best in the experience of nearly thirty years since this company commenced business, are clearly set forth. The annunciators for which this company are well known are shown by numerous cuts and listed in a variety of styles and sizes. The numerous signal and alarm systems offered are also shown and the extensive line of bells, pushes and accessories that are used in connection therewith are given. A list of hotels in which the Partrick & Carter Co.'s point needle annunciators are in use is given, which includes hotels in every part of the country from Maine to the Hawaiian Islands. Besides this list there are some thirty thousand other buildings of various kinds in which the company's systems are used. Novel designs of various fittings and appliances are presented. Insulated wires, annunciator and magnet wires, insulating material and wiremen's tools are some of the supplies listed in this catalogue. The matter is well arranged and the catalogue will be found of great assistance in selecting and ordering supplies.

PERSONAL.

G. E. Paine has been appointed manager of the Chicago office of the Postal Telegraph Co.

Mr. Chas. D. Jenney, of the Jenney Electric Motor Co., of Indianapolis, Ind,, was in Chicago on business recently.

Mr. George C. Hoffman, formerly with the Westinghouse company, has accepted a position with H. B. Coho & Company.

Mr. Frank X. Cicott, manager railway department of the Pettingell, Andrews Co., Boston, was in Chicago for a few days last month.

Mr. Henry F. Kellogg, formerly with the Whitney Electrical Instrument Co., and well known to the trade, is now connected with W. B. Southgate & Co.

Mr. C. N. Black has been appointed superintendent of the works of the Brush Electric Co., at Cleveland, in place of Mr H. W. Phipp, recently resigned.

Mr. W. M. Goldthwaite has resigned as city electrician of Alameda, Cal., and will probably be connected with the sales department of a manufacturing company.

Mr. J. C. Calisch represents the Ft. Wayne Electric Corporation at Rochester, N. Y., and has recently opened an office at 761 Powers Blk., from where he will direct the sale of apparatus in western New York and northern Pennsylvania.

Mr. W. H. McKinlock, president of the Metropolitan Electrical Co., accompanied his family to New York the early part of the month, and saw them aboard the steamer "La Touraine."

for Paris. Mrs. McKinlock, son and daughter, will be absent about a year.

Mr. Edward R. Grier, of Grier Bros., western representatives of the Bryant Electric Co., and R. Thomas & Sons, Chicago, was married on April 16 to Miss Lucy Parthenia Bosworth, at the residence of the bride's mother, Mrs. Edward Bosworth, 3 Park Place, Lee, Mass. Mr. Grier is a young man well liked by the trade, where his pleasant manner and strict attention to business has won him many friends. Mr. and Mrs Grier will make Chicago their home after a short trip in the east.

BUSINESS NOTES.

The Jenney Electric Motor Co , Indianapolis, has secured for its Chicago agents the firm of Frantzen & Bennett.

S. F. B. Morse & Co., general western agent for Day's Kerite at Chicago, have secured new quarters at 1014 and 1015 Marquette building, at the corner of Adams and Dearborn streets.

The Brady Mfg. Co., Brooklyn, N. Y., manufacture special machinery, and prepares drawings, patterns and designs for tools and machinery. The company's long experience is a great advantage in this work.

Frank H. Stewart & Co., 20 N. 7th St , Philadelphia, will conduct the electrical supply business heretofore carried on by Frank H. Stewart. Mr P. Logan Bockius has been admitted as a partner in the new firm.

The Electric Appliance Co., 242 Madison St., Chicago. reports a large demand for the swinging ball lightning arrester which has been so popular since it was first placed on the market. The company has also filled several large orders for Paranite telephone cables.

Ernest W. Cooke, 1649-1651 Monadnock Block, Chicago, reports business as very good. Mr. Cooke has general supervision for the entire west of the business of the Eastern Electric Cable Co., the Mason Regulator Co. and Chas. E. Chapin. The outlook is certainly improving.

The Stanwood Manufacturing Co., Chicago, manufacturers of the well-known Stanwood steel steps, has just removed its factory and offices to 807 and 809 E. 61st st. At the new location the company will have greatly increased facilities for carrying on its business, and we wish them much success.

W. S. Louttit, Dexter Building, Chicago, has just taken the general western agency for the Sterling Supply & Manufacturing Co. of New York. This company makes a specialty of car registers, sand boxes and fenders for street railways. Mr. Louttit reports business as improving and outlook good.

M. A. Knapp, Chicago, recently moved into new offices at 1128 Monadnock Block, where he is making a specialty of insulated wires and cables and is meeting with marked success. In addition to this specialty Mr. Knapp also sells all kinds of electrical supplies, including telegraph, telephone, railway and lighting.

Boudreaux Dynamo Brush Co., Postal Telegraph Building, N. Y., reports that the demand for brushes during the past month has been very heavy, which speaks well for the success of these brushes. The tests of the brushes for use on reversible motors are nearly completed, and the brushes will be placed on the market in a short time.

The Electric Heat Alarm Co., Boston, Mass., has recently contracted, through its St. Paul office, to equip the Ryan Hotel with its system of automatic fire alarms. A very nice office outfit has recently been finished for the Continental Commerce Co., 44 Pine St., N. Y. Other contracts for their alarm systems are keeping the factory busy.

The Metropolitan Electric Co., 186 Fifth avenue, Chicago, has made a new departure by the establishment of a bargain counter on which can be found a complete line of useful devices at hard times prices. The company has recently placed in its sales rooms a very fine sample board, showing a complete assortment of pliers, splicing clamps, vises, etc.

The Perkins Electric Switch Mfg. Co., Hartford, Conn., of which Mr. G. W. Conover is western manager, has found it necessary to remove its Chicago offices to larger quarters, 1537 and 1538 Monadnock Block. This change has been made necessary through the rapid increase in its western business. Mr. Conover reports business with him very promising.

Morris & MacCurdy, Indianapolis, report that the sale of their new insulating paint is meeting with a marked increase. Orders are being shipped daily to all parts of the country, among their customers being many of the largest of the manufacturing companies. The firm are at present doing a good business in the line of supplies and construction work. A large stock of everything is carried, and their new store affords ample facilities for carrying on the business.

The Wallace Electric Co., Chicago, has just moved to its new and commodious quarters, mention of which was made in these columns last month. The change to new quarters is most desirable in every respect. Among the leading agencies recently secured by this company is that of the Boston lamp. The company is selling a great many of these lamps, and a specialty it is now pushing is that of the renewing of burned-out lamps, which is a matter of great saving to the consumer by the return of the base and glass.

J. E. Roads & Sons, Wilmington, Del., report that during the past few weeks business has improved greatly, more orders and a larger number of inquiries for Volta dynamo belting. Among recent orders is one for a 43½ inch extra heavy double driving belt for a large cotton mill. This belt is about 136 feet long and will weigh about 1,000 pounds when finished. There has also been a large demand for Roads leather belt preserver and the sales have been unusually large. The new bell cord branded Tannate is meeting with great success, its great strength and durability being qualities especially desired.

The Beacon Vacuum Pump and Electrical Co., Boston, Mass., has on the market a complete line of high candle power incandescent lamps of from 50 to 300 candle power. The price should be right a " penny a candle-power." These large lamps are found very advantageous for many places where a large amount of light is desired. The lamps were in great demand before the lamp injunction went into effect in 1893 but the price was never so low for the same grade of lamps. "A penny a candle-power" is a price as attractive as the lamps. Beacon lamps of smaller candle-power are well-known to lamp users.

Wm. Baragwanath & Son, Chicago, the well-known manufacturers of feed water heaters and purifiers, have a number of good contracts on hand, and are consequently quite busy. The firm have just finished five large condensers for the Crystal Plate Glass Works of Crystal, Mo., and are now fitting up the Chicago city lighting plant, corner Harrison and Blue Island Ave., with condensers. Two complete outfits have also just been shipped to ice-making plants, consisting of heaters, steam filters, reboilers, silicate filter, charcoal filter, etc. In addition to this the firm are filling some half dozen local orders for heaters, ranging from 100 to 300 horse-power:

Osburn Bros., Chicago, in order to take care of their increased business, are compelled to move to larger quarters at 296 Dearborn St., where they will carry a full line of electrical and engineering supplies. Greater facilities for the transaction of business will be had, they having secured an entire basement in connection with the store for carrying stock. In order to accommodate their growing business the firm have been incorporated under the name of the Osburn Electrical Supply Co., and hereafter will be known by that name. Among the specialties secured and which will be handled by the new company are that of the Elliott-Lincoln dynamos and motors and the western agency for the McNamara Bros.' slate quarry.

Andrews & Johnson, Chicago, the well-known manufacturers of ventilating apparatus, fans, etc., whom it will be remembered were burned out some weeks ago, their plant having been located in the Kaestner Bld., are now located in the Scoville Bldg., 250-254 S. Clinton St. In the fire all their patterns as well as machinery and tools were destroyed but were covered by insurance, so that the actual loss sustained is not more than $2,500. The new factory occupies a space 66x150 feet, new machinery having been put in throughout and equipped with every convenience, so that the firm are now better prepared for business than ever. The work in hand at the time of the fire has been delayed but little, as steps were at once taken to make new patterns. They now have a full stock and are well prepared for the spring trade. Among work now under contract may be mentioned that of eight school buildings, for which they are furnishing the ventilating apparatus, also the contract for the complete ventilating apparatus for the Old Colony Bldg., as well as the new Music Bldg. and the McCormick Memorial Bldg. The firm are to be congratulated upon their enterprise and push.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED: Position as manager or superintendent of central station. Experienced and in every way qualified. Address, Geo. W. Kendrick, Front Royal, Va.

AGENT WANTED for the U. S. A. for the sale of first-class German electric carbons, on commission; apply to FERDINAND HOTZ, 1318 Masonic Temple, Chicago, stating references.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

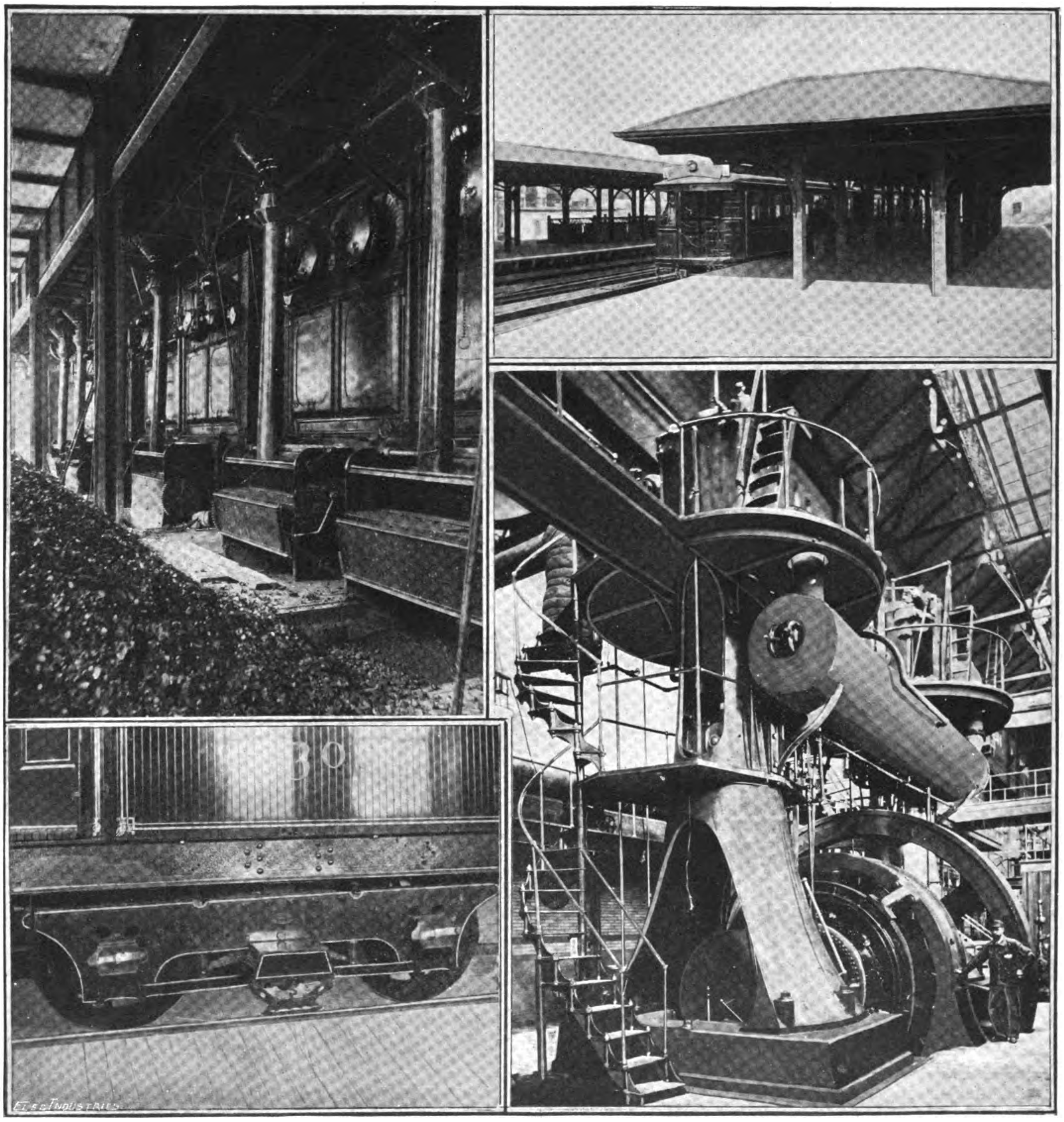
A new dining Car Service between Chicago and Buffalo via the Nickel Plate Road has recently been placed at the disposal of the traveling public, which will enable patrons of this favorite low rate line to obtain all meals on trains when traveling on through trains between Chicago, New York and Boston. For reservations of Sleeping Car space and further information see your local ticket agent, or address J. Y. Calahan, General Agent, Chicago.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. June, 1895. NEW YORK. No. 6.

The First Permanent Electric Elevated Railway System in America.

In 1883 Chicago had the proud distinction of having at the Chicago Exposition the first electric railway, built and operated by Edison and Field; ten years later at the World's Columbian Exposition, Chicago had the first all electric elevated railway in America and last month there was opened to the Chicago public the Metropolitan West Side Elevated Railroad, the first permanent electric elevated railway in America. The Intramural railway at the World's Columbian Exposition carried passengers numbering in the millions and attracted the attention of several times that number. The many advantages of electric power for moving trains on such roads were conclusively shown, although the elevated structure and many of the details on account of their temporary character permitted but approximate results to be obtained. The records of a year's operation



BOILER ROOM.
MOTOR CAR TRUCK.

STATION WITH TRAIN AT PLATFORM.
ENGINE AND GENERATOR.

FIGS. 1, 2, 3 AND 4.—THE FIRST PERMANENT ELECTRIC ELEVATED RAILWAY IN AMERICA.

of this new road it is confidently expected will show a large saving and the public will without doubt show its appreciation of the improved means of transportation by a liberal patronage of the lines. The lines are not all completed but the passengers now carried number from twenty-five to thirty thousand and are constantly increasing.

The road has the disadvantage common to the other elevated roads of Chicago in that the terminal station is at a considerable distance from the center of the business district. The difficulty of securing the right of way in the center of the city has so far stopped all attempts to secure a more central terminus. A combination of the elevated railway interests with business interest might effect a plan which would secure to the passengers transportation to the center of the city, or from one part of the city to another, by the elevated roads, without taking the surface lines.

The right of way was obtained in all cases by purchase, differing in this respect from most elevated roads previously constructed. The permit to cross the streets was obtained from the city council in 1892. The lines of the road all lie in what is known as the west side with the exception of a short section of the main line which crosses the river to reach the terminal station on Franklin St., between Jackson and Van Buren streets. It was necessary in many cases to tear down or move the buildings from the right of way. Several large brick blocks were moved. The road has four branches reaching four different districts. The western branch runs directly west to W. 46 St. The most northerly branch runs north near Marshfield Ave. to near Milwaukee Ave., where it turns and runs in a northwesterly direction to Logan Sq. Between these two branches there is another branch running directly west from near the corner of Milwaukee and North avenues to Crawford Ave. The fourth branch, known as the Douglas Park branch is not yet completed. It is to run south from the main line at Marshfield Ave. to 21st St., then directly west to Central Park Ave. The main line from the terminal station to Marshfield Ave. has four tracks. The branches are each double tracked.

The power house which is located on the main line near Throop St. is substantially built of brick and was planned with special reference to the accommodation of the immense generating apparatus it now contains. In plan the building comprises a long engine and dynamo room extending east and west; north of which and running parallel to it is the boiler room. Between the two rises the great brick stack 150 feet. In the basement beneath the engine room are to be found the auxiliary appliances used in the generation of power. The engine room has two galleries on each side extending the entire length of the room with cross galleries at the center. At the side and near the center of the room are the engineer's offices on the first gallery and below them are lockers, closets, etc. The power house is 300 by 90 feet and is 78 feet high. It was erected by the same construction company that built the elevated structure and for which Mr. E. W. Eckert was chief engineer.

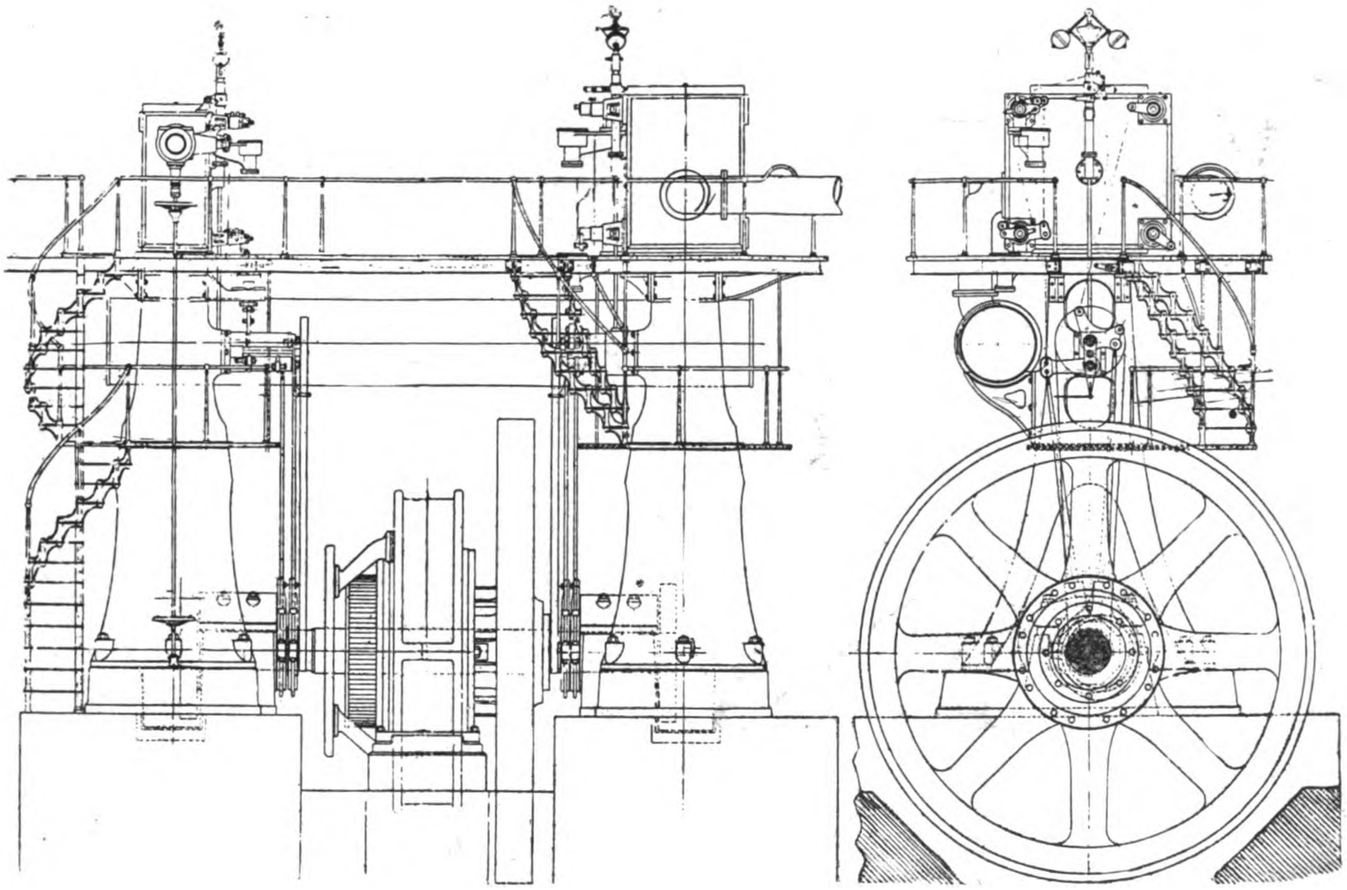


FIG. 5.—THE FIRST PERMANENT ELECTRIC ELEVATED RAILROAD IN AMERICA.—DETAIL OF ENGINE.

The power plant is conservatively rated at 6,000 horse-power but really has a capacity much above that. The engines are guaranteed to work successfully up to 9,000 horse-power. The generating plant is divided into four units, the armatures of the electric generators being mounted on the engine shaft. The size of these units is scarcely appreciated by the visitor to this power house where all the machinery is on the same grand proportion. The engines are placed in a row in the engine room. The space is so fully occupied, however, that there is a passage way of only reasonable width between the walls and fly-wheels.

The general design of the engines and generators is clearly shown in the accompanying engravings and line drawings. The engines are the Reynolds-Corliss, built at works of the Edward P. Allis Company, Milwaukee, Wis.

They are vertical, cross-compound, condensing engines, of a pattern recently designed by Mr. Edward Reynolds, superintendent of the company. The two cylinders are supported independently and the electric generators are placed between the two. This arrangement is symmetrical and permits of a substantial construction. The two main frames of the engine contain the bearings of the shaft, between which the armature and flywheel are mounted and keyed to the shaft. The connecting rods for the two sides of the engine are connected to overhung cranks on the ends of the shaft. The frame has broad bases, which are substantially bolted to the foundations; there is consequently no vibration.

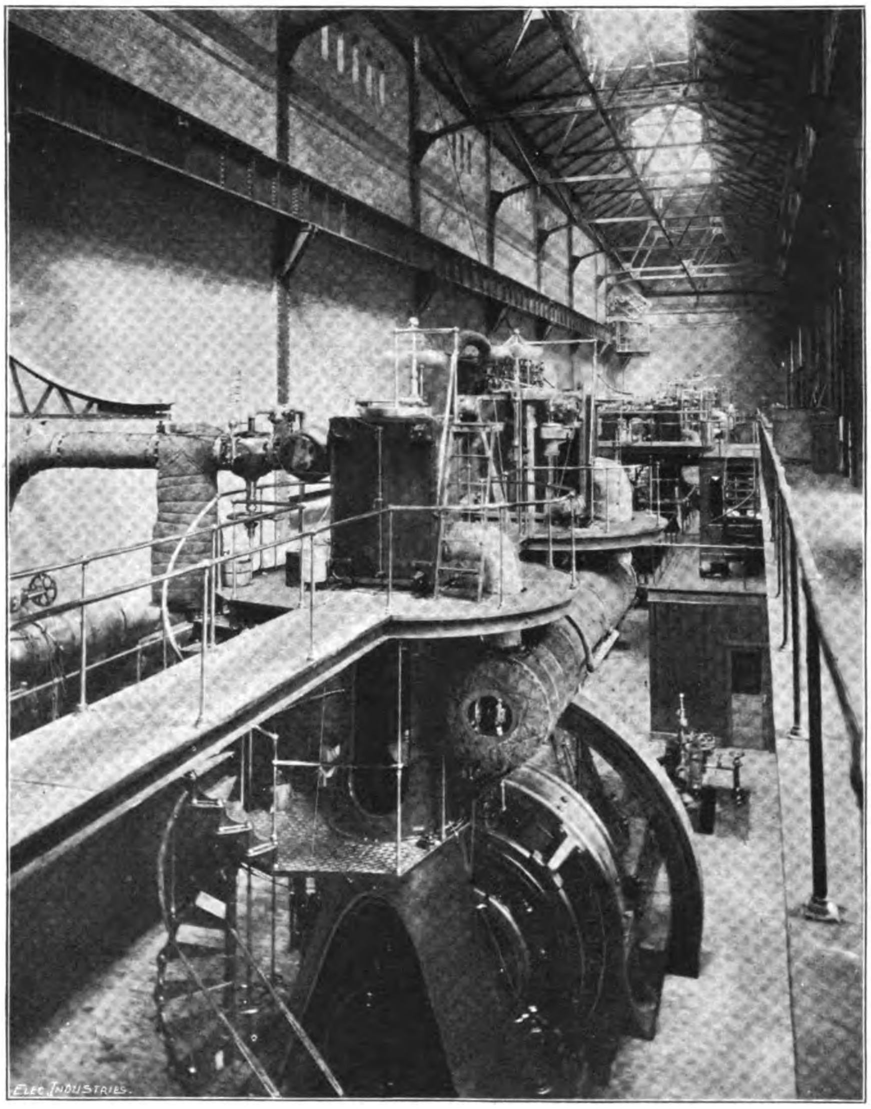


FIG. 6.—THE FIRST PERMANENT ELECTRIC ELEVATED R. R. IN AMERICA.—ENGINE ROOM.

The cylinders of the larger engines are in size 36 inches diameter for high pressure and 72 inches for the low pressure, with a 48-inch stroke. Each cylinder is fitted with a special Reynolds-Corliss valve gear, which allows cutting off steam at any point from zero to three-quarters stroke. The cut-off in both cylinders is controlled by a heavy Reynolds fly ball governor, and the valve gear is also arranged so that if desired the low pressure cut-off may be set by hand instead of being controlled by the governor. Each engine is provided with a separate governor, which controls a butterfly valve in the main steam pipe. This governor is set so that if anything should happen to the governor which controls the speed of the engine, it would close the valve before the speed of the engine increased to a dangerous point.

The engine cylinders are encircled and are also connected by iron walks with brass hand rails and neatly designed stairways following closely the engine frame, permitting any part of the engine to be reached. The upper gallery has a walk connecting with the gallery of the engine. The shafts of these engines are 24 inches in diameter and 22 feet long. The crank and crosshead pins are ten inches long by ten inches in diameter. The fly wheel is 24⅓ feet in diameter and weighs 75 tons. The engine with steam at 125 pounds pressure has a speed of 75 revolutions per minute. Each of these two engines has a Reynolds improved vertical air pump and condenser, with air pump 36 inches in diameter, with 16 inch stroke, driven by a Corliss steam cylinder 16 inches diameter and 16 inch stroke. These engines are guaranteed to work successfully with a maximum load of 3,100 horse power. The smaller engines are similar in design to the above, differing only in sizes of the various parts. The cylinders are, high pressure 22 inches, low pressure 46 inches in diameter with 48 inch stroke. The main shaft is 22 inches in diameter and 20 feet long; the crank and crosshead pins six and one-half by six and one-half inches, and the fly wheel is twenty feet in diameter and weighs 35 tons. The air pumps and condensers are similar to those with the larger engines but smaller. These engines have a guaranteed capacity of 1,500 horse-power. One large foundation of masonry supports the engine and generator. The main bearings are just above the engine room floor, which places nearly one-half the fields of generator and fly wheel below the floor. The armature of generator is keyed to the main shaft close to the fly wheel.

The generators were furnished by the General Electric Company and are all of the same type. Although this type is extensively used in railway power houses a number of improvements are noticeable. Two of the generators are of 1,500 kilowats capacity and two of 800. They have twelve poles, which, together with the field ring, are cast steel. The field coils are the same as those previously used. The machine is slightly over compounded. The armature is built up in the manner now adopted in the construction of power generators. The windings are copper strips insulated, placed in the slots of the armature core and connected to the commutator segments in the usual manner. The armature is of an unusual size and required a large quantity of copper in its construction. Great mechanical strength was necessary as well as a proper distribution of the material. The commutator is also remarkably large. In the design of the brush holders and supporting ring a great improvement has been made. Formerly the supporting frame covered the brushes and commutator, so that they were not easy to reach. The supporting ring is now attached to the frame and the brush holders are attached to brackets projecting toward the commutator. The connections from the brushes are brass strips that, as shown in detail B, Fig. 8, are connected to the brass ring, which connects the alternate brushes and the terminals of the cables leading to the switch board. This plan leaves the brushes open where they can be examined by the attendant standing in front of the machine.

The switchboard is located near the center of the upper north gallery, a position from which all parts of the engine room are visible. The board is built up of black slate, supported by an iron frame. It is 28 feet long, 8 feet high and is composed of 12 panels, 28 inches wide. Of these 12 panels the two at each end are generator panels and the six center panels are feeder panels. The switchboard is very neatly designed and all parts have been made with a view to durable and efficient service. On the face of each generator panel are an automatic circuit breaker, an ammeter, handwheel of rheostat, switches and recording wattmeter. The back of the board is shown in Figs. 10 and 11. The bus bars are heavy copper bars, with a five inch face and thickness of one inch. The leads from the generators pass beneath the floor, being carried in a rack, as shown in Fig. 9, to a point directly beneath the switchboard, where they turn and run in enclosed racks to the back of the switchboard. The insulators used were especially designed for heavy cables. They are square, with a center hole, but are divided so as to be placed around the cable. These cables are one million circular mils in size.

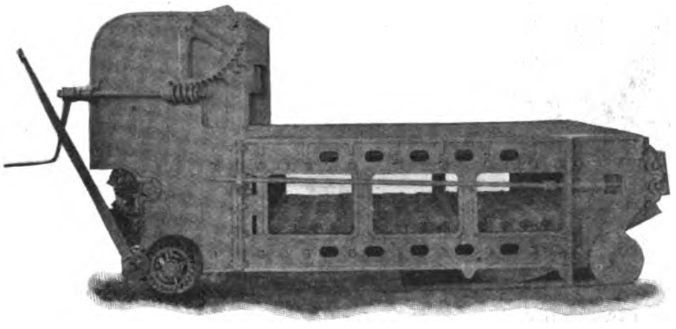
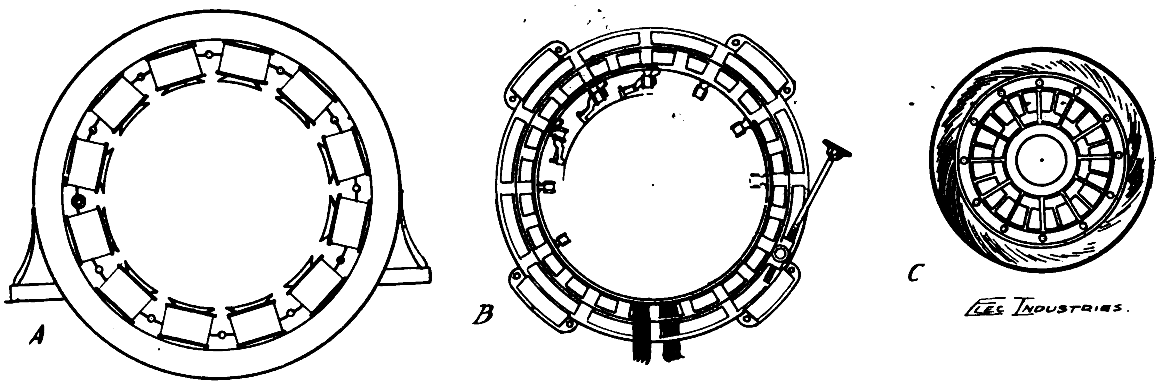


FIG. 7.—AUTOMATIC STOKER.

The equalizing cables are not run to the switchboard but are run along under the lower gallery in brackets, as shown in Fig. 12. The leads from the machines to these cables first run to a large switch placed on a standard near each machine. The feeder panels are provided with automatic circuit breaker, ammeter and switch. The leads from these six panels run to each of the six blocks, into which the railway system is divided. The back of the feeder panel is also shown in Figs. 10 and 11. The enormous amount of power transmitted required in the construction of the switchboard the use of heavy material of all kinds. The feeder cables are carried to the feeder rails, described later, on the south side of the power house and the return cables are brought from the elevated structure on the north side of the power house.

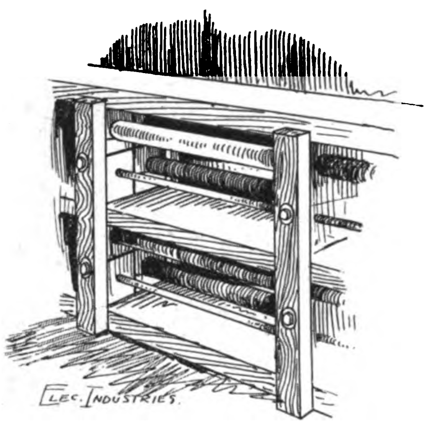


A—Fields. *B*—Brush Ring. *C*—Armature.

FIG. 8.—THE FIRST PERMANENT ELECTRIC ELEVATED RAILROAD IN AMERICA—DETAILS OF GENERATOR.

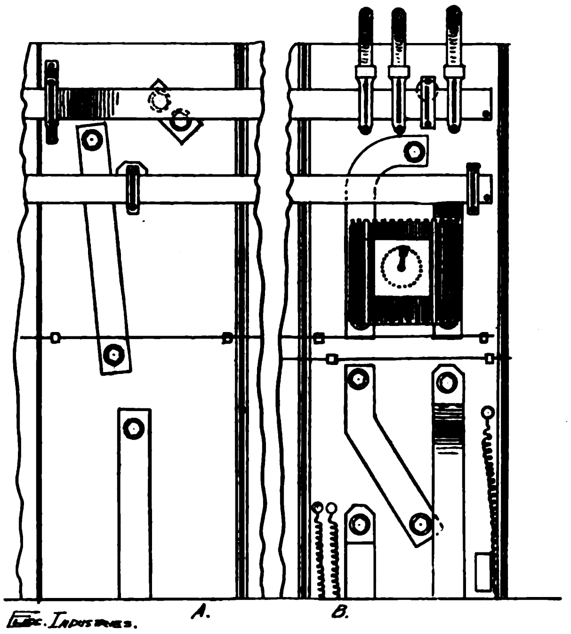
Another important part of the equipment of the engine-room is the 20 ton traveling crane, built by the Morgan Engineering Co. It runs the entire length of the building and is operated by electricity, the motor being fed from a small trolley wire just inside the track. In the basement beneath the engine-room are located the large Berryman feed water heaters, the Worthington and Deane pumps and a Clayton air compressor. There is also in the basement a set of oil tanks and purifiers made by the Peoria Automatic Filter Co.

THE BOILER ROOM with special methods for the economic delivery and handling of coal possesses several features of interest. It contains twelve 300 horse-power Babcock & Wilcox boilers, erected in batteries of two each. These boilers are of the standard type made by this company and are fitted with Babcock & Wilcox automatic stokers. This stoker is shown in Fig. 7 as it is drawn out from the boilers. The feed is regulated by a handle on the front of the hopper. The coal is fed into the hopper from bins located above the boiler-room through chutes as shown in the engraving on page 147, which shows one-half the boiler room. The supply is increased or cut off by means of a chain at the side of boiler which controls the valve. The grate of this furnace consists of an iron link belt running over sprockets at the front and rear. When properly regulated, which can be easily done by watching the fire, combustion commences before the coal has traveled many inches and the first gases pass over the glowing coals before passing through the boiler. By the time the coal reaches the end of the furnace it has been reduced to ashes, which are thrown into the pit below. An even, steady fire is assured. The stoker can be drawn out from under the boiler at any time. The gases pass from the boiler directly to the immense stack, 150 feet high, which rises above the boiler room. The draft can at any time be increased by the use of the two Sturdevant blowers. The coal will be delivered to the road from the belt line as soon as the switch connection is made and will be drawn to the power house


Elec. Industries.
FIG. 9.—FEEDER CABLES AND RACK.

over the regular line. A switch will run into the power house above the boiler room and the coal dumped into the bins from the cars.

The railway system is divided into six blocks, each of which is supplied by a separate set of feeders from the power house. These feeders are made up of 45 pound T rails as shown at F, Fig. 14. They are run between the tracks on the ties and are boxed in, the cover forming a walk for workmen inspecting or repairing the track. They are bonded in the same manner as the third rail described below. The number of rails in each feeder is determined by the distance of the block from the power house and the probable number of trains on that block at one time. The feeder rails are connected to each of the third rails on the double track branches.



FIGS. 10 & 11.—DETAIL OF BACK OF DYNAMO AND FEEDER PANELS.

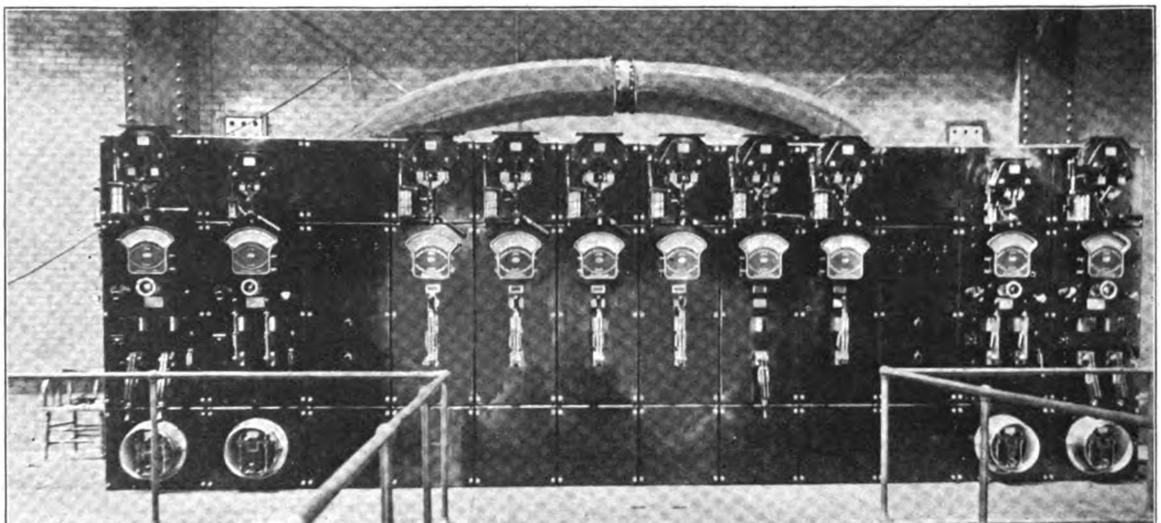


FIG. 13.—THE FIRST PERMANENT ELECTRIC ELEVATED RAILROAD IN AMERICA—THE SWITCHBOARD.

The rails from which the current is taken, known as the third rails, are placed between the two tracks and near the track rail as shown in Fig. 14. They are placed six or eight inches higher than the track to give room for insulation and to allow the contact shoe to be placed high enough to pass the rails at switches and turn outs. The blocks to which the rails are spiked, are oak boiled in paraffine, six inches square. The bottom of the block is bored out and and cast bracket of the shape shown (C Fig. 14) is fastened by screws to this block and attached by lag screws to the tie. This bracket touches the block only at the top and leaves three-quarters of an inch of clear space at the sides. This arrangement prevents the water during storms making a short circuit. It gives a good firm support to the rail and has not been an expensive method of insulating. These rails are fastened together by two bolt fish plates which fit closely against the rail. The rails are bonded with flat copper bonds made at the company's shops. The strips are about three-sixteenths inch thick and two of them just cover the bottom of the rail. They are carefully tinned after being drilled for the rivets, which are five-eighths of an inch in diameter. The rivets are tinned and are forced into the hole which is a little smaller than the rivet and soldered. The bonds are riveted to the rails immediately after being drilled and as soon as the bond is on before it has had a chance to corrode the whole is painted a heavy coat of P. & B. paint.

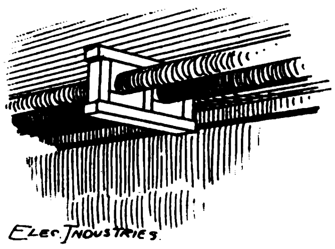
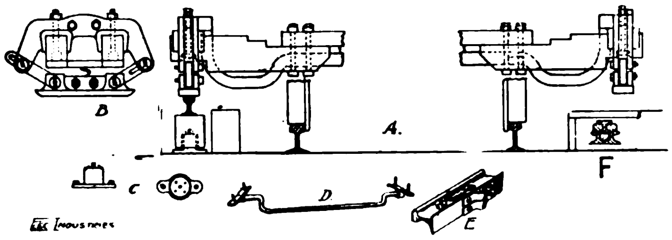

Elec. Industries.

FIG. 12.—EQUALIZER CABLES.

The two rails are also bonded together every eight or ten rail lengths by similar bonds connected by copper cable. The rails are not far apart both being between the two tracks and bonding is an easy matter. By this method the trains on either track have the feeder cross section of the two rails. The track rails are bonded to the iron structure of the road. The large cross section and heavy riveted joints gives an admirable return. The entire structure is thus grounded. The bonds used for this purpose are bare copper wire and the bond is made at the center of each rail. The track rails are not bonded at the joints. The entire system for the transmission of the power has been installed in a simple, but durable and efficient manner. The use of rails in place of copper was found to greatly lessen the cost as they are easily insulated and occupy little room on the elevated structure. A considerable amount of special work was necessary in designing suitable arrangment at switches, etc., for the sliding shoe.

The motor cars, of which there are now 55, were built by the Barney & Smith Car Company, of Dayton, Ohio, the trucks by the Baldwin Locomotive Works and the 100 trailers by the Pullman's Palace Car Co. The motor cars are forty-seven feet two inches by eight feet seven inches. The weight of the car without motors is 20 tons. The cars are all neatly finished. The motor equipment consists of two 133 horse-power G. E. 2,000 motors mounted on one truck, one to each axle. These motors are of the single reduction type with steel frame and iron-clad armature. In Fig. 16 is shown one of the motors with door over commutator thrown back.



A—Detail of track and contact shoes. *B*—Side view of contact' shoe. *C*—Bracket supporting insulating block. *D*—Bond. *E*—Joint and bond of third rail. *F*—Feeder.

FIG. 14.—DETAILS OF TRACK CONTACT SHOE WITH METHODS OF BONDING.

Each truck carries on each side a contact shoe as shown on page 147. This shoe is supported from a wooden beam by links which give the shoe sufficient vertical motion to reach the third rail. The shoe is connected by a flexible cable which runs to the controllers. This shoe is shown in detail in Fig. 14. Its weight is sufficient to give a good contact. There are four of these shoes to each car; both of the shoes on one side of the car are in circuit. This gives a double assurance of a good contact. The shoes on the other side of the car are found necessary not only when the car is running on the other track but also at switches, cross overs, etc. At each end of the motor car is a cab for the motorman. It covers one-half the platform and takes up an equal amount of space in the car. Fig. 15 shows an interior view of the cab with cover of series parallel controller removed. The automatic circuit breaker is noticeable at the left. Just below it is a fuse block and automatic motor starter for the air pump and in the corner the controller with handle removed. The air pipes of the air brake system are also shown. The position of the motorman is directly between the two with the controller handle in the left hand and valve handle of air brake system in the right. Directly in front of the motorman is the air pressure guage which shows by one pointer, the pressure of the air in the reservoir, and by another, the pressure in the train pipe and brake cylinders. The brakes are the New York Air Brake Co.'s. Each car has an air pump operated by a three and one-half horse-power Storey motor. The motor is automatically started and stopped as the pressure in the reservoir is below or above 60 pounds pressure.

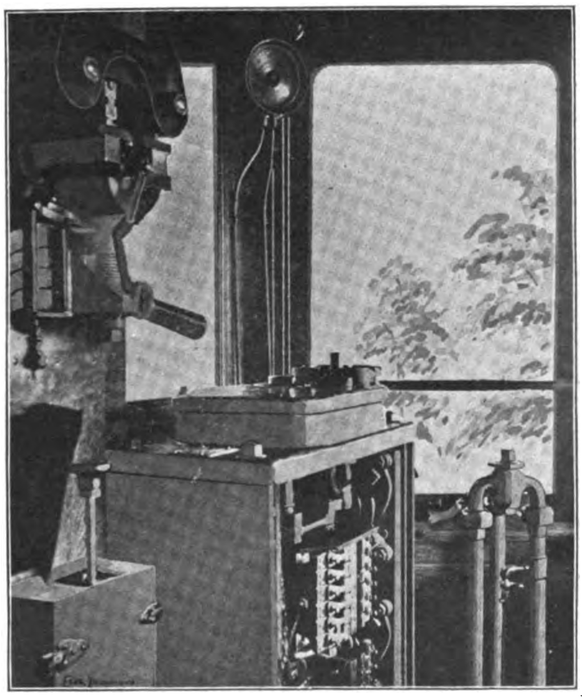


FIG. 15.—VIEW IN CAB OF MOTOR CAR.

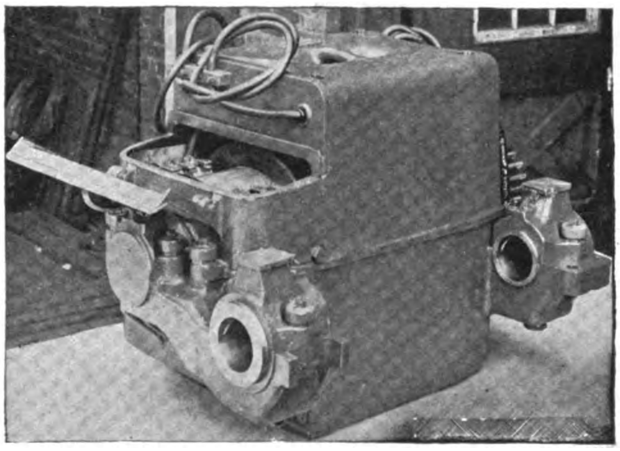


FIG. 16.—VIEW OF MOTOR, SHOWING COMMUTATOR, BEARINGS, ETC.

The series parallel controller although in some respects similar to those used on the Intramural at the World's Fair has been greatly improved. A special feature is that it makes it possible for the motorman to throw both motors in series or parallel when starting or from one into the other. The resistance is first thrown in series with the motors in either case and gradually cut out. The cars are lighted by incandescent lights throughout and are equipped with American electric heaters, furnished by the Central Electric Heating Co., New York. The trailer sockets for connecting the lighting and heating systems are under the corners of the platform. The plugs connected by flexible cable covered with heavy rubber can be quickly inserted when a train is made up.

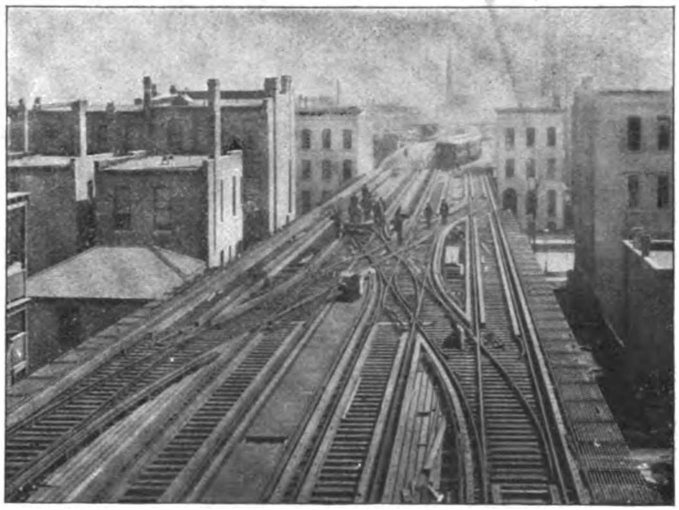


FIG. 17.—VIEW ON MAIN LINE, SHOWING TRACK.

The repair shops of the road are directly opposite the power house on Throop St., and are equipped with a complete line of machines and tools for the construction and repair work. The shops are two stories high. The cars run in on the second floor. The trucks and other heavy parts are taken to the main floor by a hydraulic lift. The power for operating the machines is furnished by electric motors. Any part of the equipment of the road can be repaired or rebuilt at these shops. The stations along the lines of the road have been substantially constructed and are conveniently arranged. The employes of the company wear neat blue uniforms.

The officers of the road are Robert E. Jenkins, president; George Higginson, jr., secretary; W. W. Gurley, general counsel; W. E. Baker, general superintendent; H. M. Brinckerhoff, electrical engineer; A.S. Jones, superintendent of transportation, and M. H. Gerry, superintendent of motive power.

Factory Practice in the Design and Construction of Dynamos.—II.

BY C. E. WOODS.

Perhaps at this juncture it becomes necessary to explain a little electrical data for the benefit of those who are not conversant with the ordinary terms which are used, and we will see if we cannot master a few of the leading principles governing the generation and propulsion (if the term may be allowed) of an electric current. Probably the easiest way to understand this law is to give a comparative case in hydraulics.

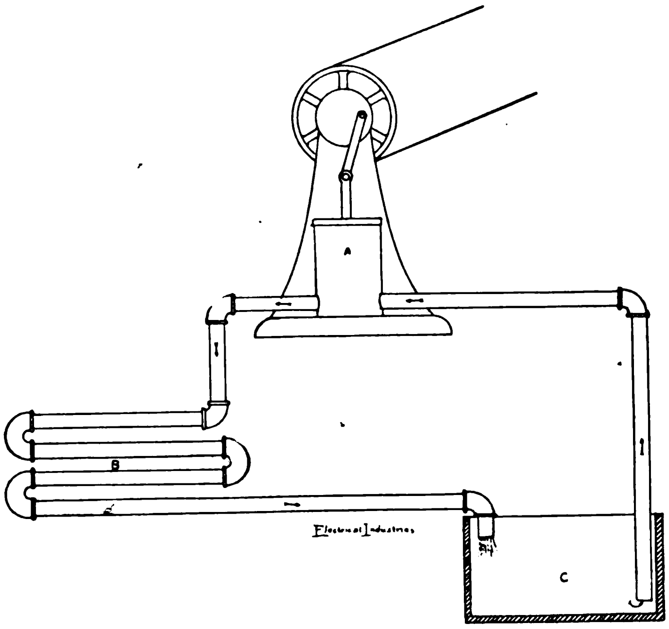


FIG. 6.

In Fig 6, where "A" is the pump, " B " the conductor or pipe for the water, and " C " the tank from which the water is both received and delivered, we have a fair illustration of what is known as the electric circuit. If the pipe and tank are filled with water, and the pump started, there will, of course, be a circulation of water from the tank to the pump; from the pump through the pipe back into the tank, then up to the pump, and so on continuously so long as the pump is in motion. The pump does nothing but furnish the power to move the water in the pipe, which water is moved by the pressure exerted upon it by the power delivered from the pump, and the rate of flow or quantity of water which will flow in a given time depends upon the amount of such power. If the application of power be doubled, friction or resistance to the flow of water remaining constant, the quantity of water traversing the pipes in the same length of time would be doubled. This example is fairly analogous in illustrating the principles of the flow of a current of electricity in which the dynamo replaces the pump and which generates the pressure to send the electricity through the circuit (pipe) which may consist of copper conductors, lamps, etc.

We will replace the pump with a dynamo which will generate a voltage (power) sufficient to send the electricity through the before-mentioned circuit of copper conductors, lamps, etc. The friction or resistance of the circuit would be analogous to the pipes to the water and the amount of current would be represented by the quantity of water through the pipe. However, instead of using so many pounds of pressure we use the word volt, which is a unit of electrical pressure. It is technically an electromotive force induced in the conductor which cuts lines of magnetic forces at the rate of 100,000,000 per second, or such an electromotive-force as will cause a current of one ampere to flow against the resistance of one ohm. An ampere is the quantity of current corresponding to the quantity of water we would measure in gallons, or such an amount of current as pushed by an electromotive force of one volt would pass through a circuit whose resistance is equal to one ohm. The practical unit of current is the amount of current that would flow through an ohm resistance under unit electromotive force, or one volt. The resistance of a conductor of electricity varies not only with its cross section or size, but with the kind of metal or substance of which it is composed. As before stated copper is most commonly used because of its lower cost as compared with silver which is taken as the standard.

In practice sizes of wires or conductors are designated in two ways: First, by measurements in 1,000th of an inch, and, second, by the number of circular mils they contain, a circular mil being a circle one one-thousands of an inch in diameter, and the number of these circles contained in a cross section of a piece of wire is called a size of so many circular mils of cross section, or so many circular mils wire, the other being mils diameter. A copper bar one square inch in size, contains 1,273,200 circular mils, and a round wire, one inch in diameter contains exactly one million circular mils. These two figures are given for future reference.

This question of relation between volts, amperes and resistance is expressed under one universal law, which is known as Ohm's law, $c=\frac{E}{R}$, in which "C" stands for current, " E " for electromotive force or volts, and " R " for resistance, consequently current in amperes equals pressure in volts divided by resistance in ohms, or again, electromotive force equals resistance multiplied by current; and again, resistance equals electromotive force divided by the current; thus it will be seen that these terms are dependent upon each other, and that their relation to each other is expressed by this law.

If one volt will force one ampere of current through a circuit having one ohm resistance it will take five volts to force five amperes through the same circuit. If this resistance should be increased to five ohms it would take five times five amperes for the proper number of volts to force the amperes through, which would be 25 volts. From this it can be seen that it is very easy to obtain any one of these quantities when we have the other two.

In Fig. 7, we have the armature connections of a two pole machine carrying two brushes diametrically opposite one another with current entering the armature at " B," passing out at " A," through the incandescent lamps " C1 " and " C2," and back down to " B " again as indicated by the wiring. For a moment let us cut off lamp "C2." Now, if the resistance from "A" through the lamp "C1" down to the brush "B" equal 200 ohms, and the electromotive force generated by the armature be 100 volts, one-half ampere of current will flow through the circuit. If another incandescent lamp "C2" is now turned on across the wires the same as "C1," making 100 ohms resistance, one ampere would flow through the total circuit, one-half goingthrough each lamp. It requires power to force the current through the resistance, whether in the conductor or a device such as a lamp placed in the circuit. From this it is apparent that the resistance of the wires 1 and 2 in the armature circuit must be as low as possible in order to have the full value of the electromotive force generated by the armature utilized in the external circuit, which is the circuit extending from brush to brush through the lamps. As the current enters the armature wires at "B," it will be noticed that it has two paths to flow in; consequently the size wire for two-pole armature will have to be proportioned to carry one-half of the current, and in the four-pole machines, which is what we really wish to get at (Fig. 8) it will be noticed that we have four brushes, "AA" and "BB." For illustration we will say we have four ampere entering at "C;" two amperes will go in either direction, as indicated by the arrows, to the brushes "BB," and as they enter the armature, one ampere will go in each circuit 2 and 3 to "AA," and one ampere in each circuit 1 and 4 to "AA." Consequently in the four-pole machine the size of the wire for our armature will have to be one-fourth the size of the wire which carries the external circuit. It will be noted that "BB" is connected to one of these wires and "AA" to another. This is done because "BB" might be positive poles while "AA" were negative poles, and are connected in a manner that is termed parallel connections at the brushes; that is, where two brushes of the same polarity feeds one wire of the external circuit. This same law holds in this armature as in the one shown in Fig. 7, regarding the internal resistance. The resistance of the armature wire itself through which the current has to travel must be as low as possible. How this is determined will be shown a little later on What we wish to know is the size wire that we must have for an armature which is to deliver 120 amperes.

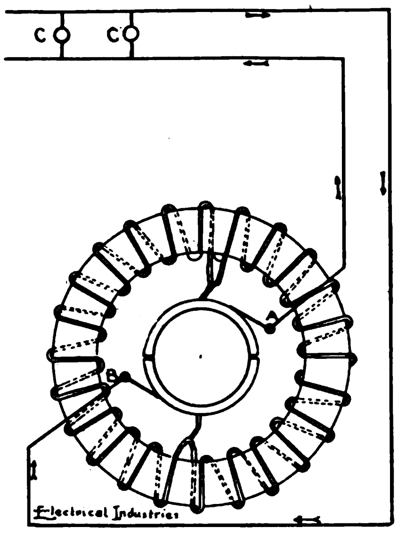


FIG. 7.

As each armature circuit or wire will have only to carry one-fourth of the whole current flowing, which would be 20 amperes, we have only to compute the size of conductor that will carry that number of amperes under proper conditions. Past practice shows that in a machine of this size, about 1,000 amperes per square inch of copper will give the right results, and 2,000 amperes per square inch of copper means 636 circular mils per ampere, and as we have 30 amperes we must, of course, have 30 times 636 circular mils, which is 19,080 circular mils. What size wire now contains the nearest number of circular mils to 19,080? This can be found from any regular wire table, and is a No. 7 wire, which is 20,816 circular mils. Consequently we must wind our armature with No. 7, B & S gauge wire, B & S meaning American Brown & Sharp's Gauge, which is the standard.

The next factor which we must find or assume is the diameter of our armature core, and the first point we have to work from to ascertain this is that about 4,000 feet per minute peripheral speed is the limit at which good design and construction is permissible. So let us assume an armature diameter of 14⅝ inches, which will give us a peripheral speed of 3,831 feet per minute.

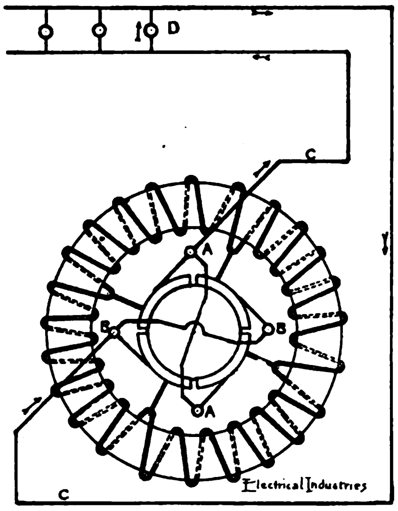


FIG. 8.

Next we must ascertain what the circumference of this armature core is, and 14⅝ inches in diameter multiplied by 3.14 times will give us the circumference of our armature core, which is 46.11 inches, or 46,110 mils. The diameter of the No. 7 wire, including insulation, is 156 mils, so that if we divide 46,110 mils by 156 mils we will have the number of conductors which we can place on the periphery of the armature, which is 295. The next consideration now is the division of this into sections, turns per section, etc.

Obituary.

ARTHUR M. WELLINGTON.

The death last month of Mr. Arthur M. Wellington removed one of the best known civil engineers in this country. He had made a reputation not only in the practice of his profession as an engineer, but also as a journalist, having been since 1887 one of the owners and editors of the "Engineering News." He secured his knowledge of civil engineering by practical experience and private study, his schooling ending when 16 years of age. By perseverance and hard study he gradually arose in his profession and occupied a number of important positions in railway service. He also wrote a number of works on engineering which were well received and are still considered the authority on the subject. He traveled extensively, was well informed and a member of the prominent engineering societies. In his work as a journalist he was persevering and original. From 1884 to 1887 Mr. Wellington was connected with the "Railroad Gazette." Even after his connection with the "Engineering News" he continued to do occasionally work as a consulting engineer. He was born in Waltham, Mass., in 1847. He was therefore in his forty-eighth year.

A Radical Departure in Dynamo Design, and the First Plant Installed.

The type of dynamo designed by Messrs. Thompson and Ryan and built by the J. H. McEwen Mfg. Co. of Ridgeway, Pa., has undoubtedly attracted more attention than any machine recently placed on the market. The design differs widely from that commonly followed in the construction of dynamo electric machinery. The addition of certain novel features has changed greatly its construction and given it special advantages. The experimental and scientific researches made by Prof. Ryan and Mr. Thompson in the investigation of the subject were described with the results obtained, in a paper recently read before the American Institute of Electrical Engineers.

While a study of the growth of the ideas involved in the design have a special interest for the scientist and the designer of electrical apparatus, a description of the new machines that have recently been placed on the market will be, undoubtedly, of greater interest to the practical man. The first dynamos of this type to be placed in service are in the new department store of A. M. Rothschild & Co., State and Van Buren streets, Chicago, where they furnish current not only for the extensive interior but also for the great tower and sign which contain nearly four thousand incandescent lights. These features of this store were described and illustrated in a recent number of Electrical Industries.

The dynamos are direct connected to McEwen automatic engines and are of 100 kilowatts capacity each. They are mounted on bases similar to those of the engines and the combination is noticeably compact. The dynamo appears small in size for its output and takes up but little more room than the fly wheel on the other end of the shaft. The outside diameter of the fields is but 50 inches and the armature is but 30 inches in diameter. The reason for the larger output for the size of machine is accounted for in its novel design and construction. The total weight of the machine is 6,000 pounds or one pound to $16\frac{2}{3}$ watts output.

The field ring and pole pieces are cast steel and are of a special form, illustrated in the accompanying detail drawings. Instead of the pole pieces projecting from the yoke the field coils are sunk into the yoke, so that the faces of the pole pieces are just even with the edge of the frame. The field coils cannot be seen from without and are almost entirely enclosed. The radiation of the heat of the coils taking place from the external surface of the field ring. This ring is cast in two pieces joined at the center.

Within the pole pieces is what is termed a pole ring and in this lies one of the novel features of this dynamo. This ring is a single steel casting fitting closely up against the pole pieces. The detail of this ring is shown in Fig. 2. Through the openings in this ring are wound broad insulated ribbons of copper, until the openings are filled. The center of these coils is directly over the opening between the field coils. The coils are called balancing coils and are connected in series with each other and the armature. Their purpose is to balance the magnetic effect of the armature, to produce a field of just the requisite strength for perfect commutation and to afford what little compounding is needed.

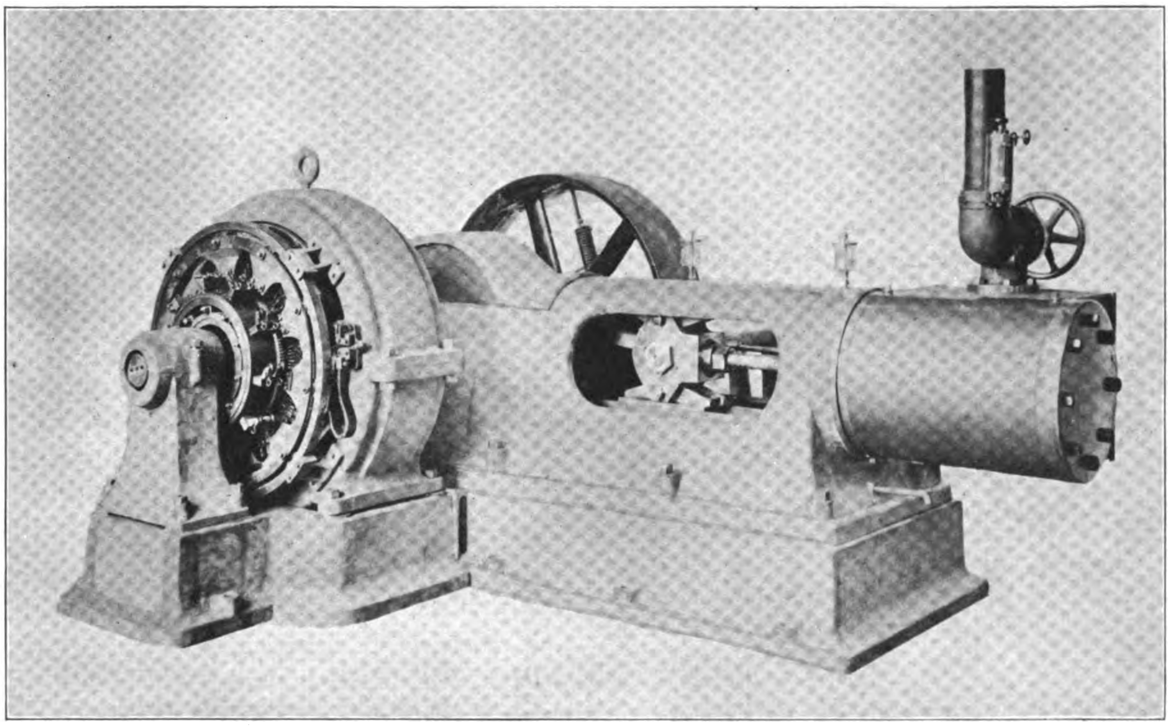
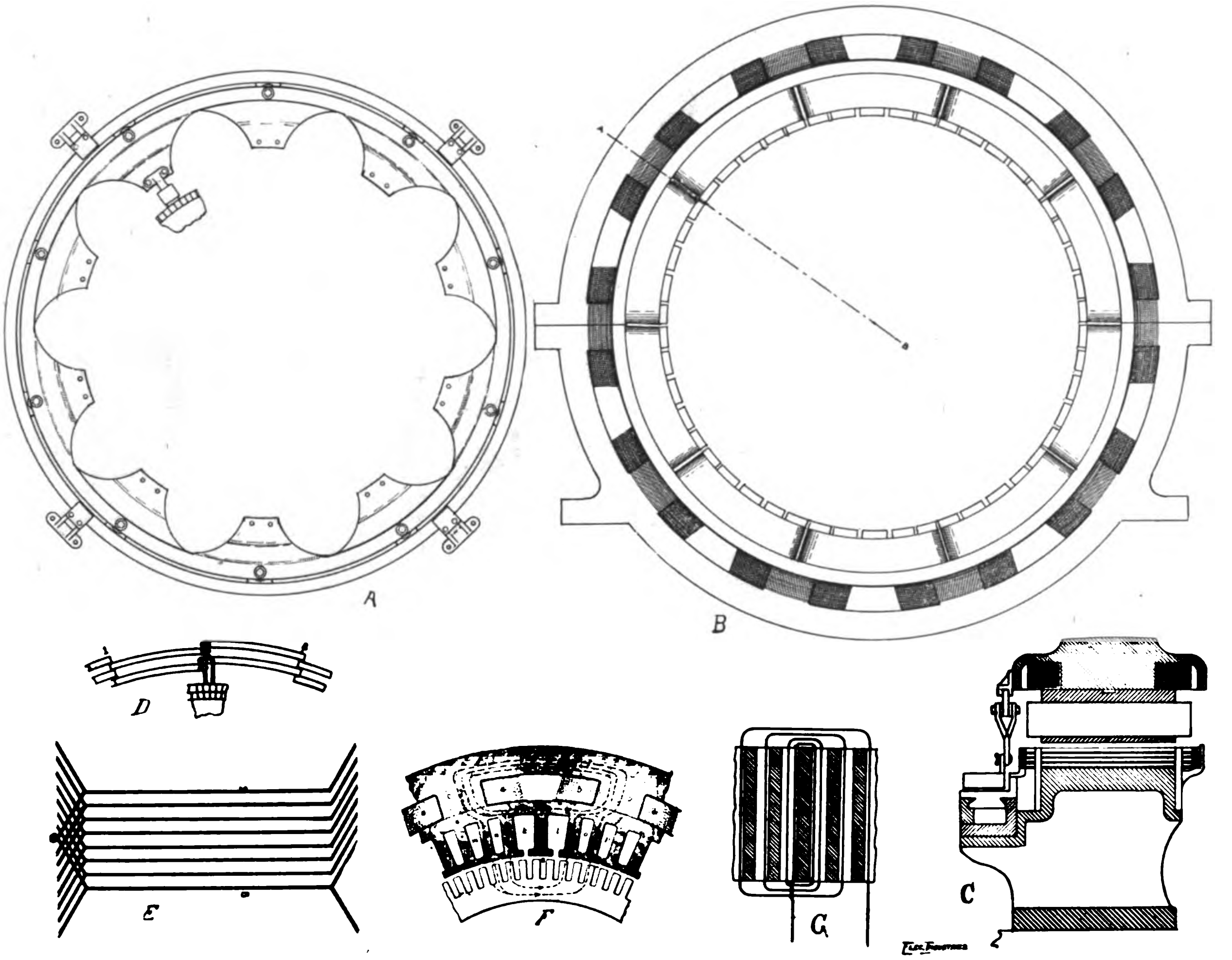


FIG. 1.—A RADICAL DEPARTURE IN DYNAMO DESIGN, AND THE FIRST PLANT INSTALLED.

The tendency of the currents circulating in the armature coils is to produce a cross magnetism through the core at right angles to the natural field of the dynamo. If a distortion of the magnetic field is thus occasioned it causes a serious diminution of the effective magnetic strength and complications preventing perfect regulation and commutation. It is the province of these balancing coils to prevent such distortion and to enable the full magnetic strength to do effective work. The detail G shows the way the balancing coils are wound in the pole ring and in B the position of these coils with reference to the fields is shown.

The fields thus present these new features, the coils enclosed in the field ring, the pole ring with its balancing coils and the great reduction in size, secure by the greater efficiency of the fields. The armature is also of a novel design, which gives it a large capacity for the diameter. The slots in the armature core are deep and give room for an amount of copper much greater than that usually found on the armature of a machine of the same size. The armature windings are copper strips three quarters by one quarter inch. These strips are thoroughly insulated before being placed on the armature. Four of these copper bars are placed in each slot and the alternate ones extend in the opposite direction as they come out at the ends, as shown at D and E. The second bar at 1 and the upper bar at 8 are joined by a simple connection and by a lighter wire to the commutator segument directly beneath it. The bottom bar and the third bar of the same slots are joined in the same manner and are connected to the next segment of the commutator. The wiring is extremely simple. The insulation consists not only of tape and shellac, with which the bars are covered but also of micanite forms that separate the different windings. The connections are both riveted and soldered. The ventilation is good, the peculiar form of the windings acting as a fan to keep up a constant circulation of air. The center of the armature is hollow and affords a large radiating surface. The entire armature is therefore well ventilated.



A—Brush ring and holders. *B*—Cross section showing fields and balancing coils. *C*—Section through fields and armature on line *A B*. *D*—Illustrating method of joining windings and connection to commutator segments. *E*—Armature winding. *F*—Section showing poles and pole ring. *G*—Detail illustrating winding of the balancing coils

FIG. 2.—A RADICAL DEPARTURE IN DYNAMO DESIGN, AND THE FIRST PLANT INSTALLED.

The shaft is of good size and has large bearing surfaces. The commutator is large in diameter and is supported on a hub of the spider, as shown in the cross section. The segments are held in the ring by horizontal bolts; the insulating material, heavy sheets of mica and hard rubber, is placed so as to cover the under surfaces and sides of the segments and the whole is accurately balanced. The brush holders and supporting rings are of new designs. An iron ring is supported in iron brackets from the field ring. The brackets allow the ring to be turned in either direction. To this ring are attached two brass rings which support the brush holders, as shown in cuts A and C. These rings are insulated from the supporting ring and from each other by insulating washers; but with that exception no insulation is required. The construction of the brush holders is greatly simplified. The leads to the switch board are connected to the brush rings. The design is certainly neat and is quite different from those commonly used on multipolar machines. The rings are held close to the field ring and the commutator and brushes are unincumbered. The advantages of this design will be at once apparent upon noticing the details.

So accurately do the balancing coils perform their work that it is unnecessary after the brushes are once adjusted to change their position. The supporting ring is therefore fastened when once the proper position of the brushes is determined. There is a remarkable absence of sparking when the dynamo is operated under a varying load. The field coils are wound on wooden spools and when slipped off are thoroughly taped. Metal spools are not used. The machine as a whole shows neat and well proportioned outlines and good mechanical construction. As one notes the care with which the machines are built and the many new features the expense of building this dynamo seems much greater than the ordinary types. This fact is, however, denied by the builders, who maintain that the saving in material and changes in the design of several parts more than make up for the added expense of other parts.

The first installation of these dynamos was made last month, as above mentioned, in the department store of A. M. Rothschild & Co., Chicago. The location of the plant is hardly the most desirable. It was the intention of the proprietors to obtain current from the Edison company until almost all the other machinery for elevators, power, etc., had been installed; consequently, the only space remaining for the electric plant was in one of the most undesirable corners next to the boiler room. The temperature is always that of midday on the equator. The dynamos are, however, carrying the load without any trouble and those in charge of the plant express perfect satisfaction with its operation. The plant includes two direct connected sets of 100 kilowatts each. The marble switchboard containing a full set of station instruments is placed near the generators. The feeder wires run from the switchboard along the ceiling on porcelain to the various centers of distribution. The lights used for lighting the interior of the store are incandescent arc, run two in series. For window lighting and the lighting features previously described incandescent lights are used.

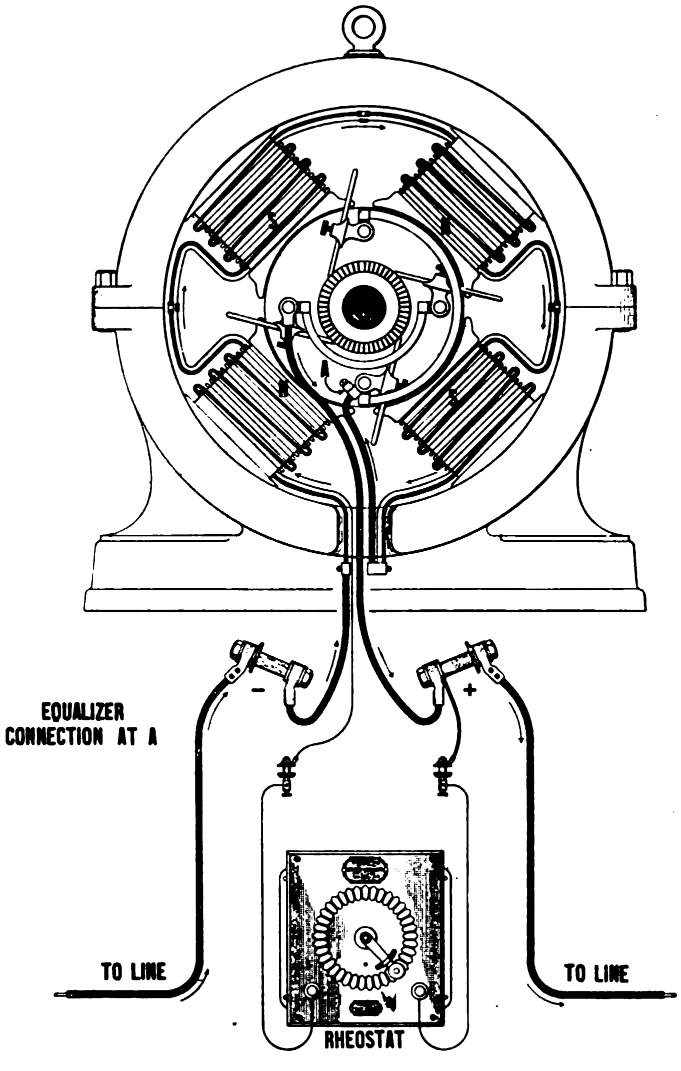


FIG. 1.—SOME DETAILS OF A NEW MULTIPOLAR DYNAMO.

The current generated is 110 volts potential and the mains are all of large cable, so that the drop to any part of the lighting system is small. The engines are of the simple type, with cylinder 15 by 16. The steam pressure is 80 pounds and the engines have a speed of 275 revolutions per minute. The foundations for the machines were substantially put in. The dynamo and engine rest on heavy iron sub-bases, which are fastened together and bolted to the foundations. The machines are thus securely anchored. The governor effects a very close regulation of the speed. The engine is substantially built throughout. Its valves have secured special attention in the hands of the builders and every part constructed with a view to the continuous service required in an electric lighting plant. The plant was sold and installed by the Wm. Sharpe Company, western agents for the J. H. McEwen Mfg. Co. Mr. Milton E. Thompson, one of the designers of the generator, was present when the plant was started.

Some Details of a New Multipolar Dynamo.

In the construction of the new multipolar dynamo recently placed on the market by the Ft. Wayne Electric Corporation, one of the most important features is the armature core. This core is built up of thin plates of sheet iron of the shape shown at B, Fig. 1. Three of them form a perfect ring with the teeth projecting from the circumference. Upon the inner surface are two hooks which enclose the bolts of the spider. In order to break joints the segments are placed over alternate spaces. This method of building up the core and securing the segments binds the whole firmly together. The strain is not thrown in the least on the spider, a fact that allows the spider to be made of smaller cross sections and the construction is unquestionably the simplest yet devised.

The winding of the armature is shown at C. It is composed of four wires of the form shown. This winding is carefully insulated before being placed in the slot of the armature core. The simplicity of the winding is one of its important points. The removal of a coil is an easy matter. The commutator connection is made by means of screws which pass through the connector on the end of the winding.

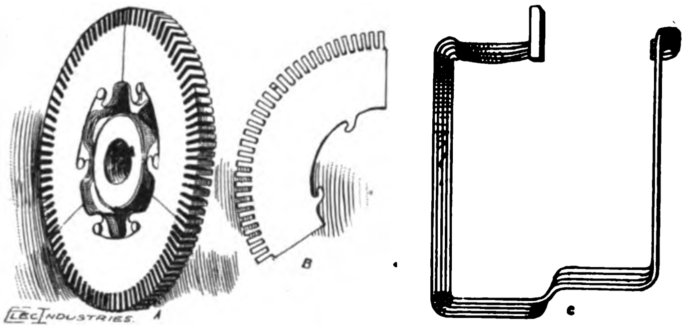


FIG. 2.—SOME DETAILS OF A NEW MULTIPOLAR DYNAMO.

In Fig. 2 is shown the field windings and the connections, the heavy lines representing the series winding and the finer lines the shunt winding. The brushes are connected by copper rods bent in the form of a half circle. The rheostat connections are also shown. The figure also exhibits the proportions of the yoke and field magnets. The frame rests on a substantial base which gives a strong construction. The openings in the frame of the machine allow the cables to be run through the floor and to the switchboard without passing out into the room. Where the cables pass through the floor outside they are constantly liable to injury unless protected by an iron covering. This method is much the simpler and insures the safety of the cables.

The first postal car on the street railways of Chicago was placed in service on May 25. On that date a number of the post office officials, together with some of the city officers, took a ride over the lines on this car. The car is divided into two parts, one of which is used for passengers and the forward one for mail. The mail compartment is equipped with all the latest appliances of the regular steam railway postal car, though on a smaller scale. There are reversible letter cases, letter and newspaper boxes, swinging pouch rack, shelves, drop tables and lockers.

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New evidences of the improvement in the business situation are continually appearing. The business of the street railway companies has increased sufficiently so that a restoration in part at least of the wages formerly paid their employes has been made. Other large employers of labor in different parts of the country have also voluntarily increased 10 per cent the wages of the workmen. The prices prevailing for both raw material and manufactured articles are better. Copper, which is extensively used in electrical work, has increased 10 per cent in price. Material for the insulation of electric wire has also increased in price so that the price of both bare and insulated wire may be expected to advance shortly. The demand for copper even at the advanced price has been so great that there is very little surplus and many of the producers are looking for a still further advance.

Interest in telephone patents has been reawakened by the reversal of the decision of Judge Carpenter declaring void the Berliner microphone patents by the United States Circuit Court of Appeals at Boston. The decision of Judge Carpenter was based upon two points, either of which was considered sufficient to invalidate the patent. The first was that the patent in suit was identical with one granted to the same inventor in 1880 now expired. The other that the issuance of the patent had been purposely delayed in the patent office for some 14 years. The reversal of this decision was a considerable surprise to those who had watched the progress of the suit. It is difficult to see in what way the judge has considered these points and upon what grounds he has based his decision. In the former opinion handed down the case was reviewed at considerable length. The various details in the issuance of the patents received especial attention.

The case will undoubtedly be appealed to the Supreme Court for the final trial, which will determine the validity of these patents. In the meantime, however, this decision is in force in the district covered by this court. The change in the status of the telephone industry cannot be so great as one would suppose from the claims made for this patent. The patents owned by the Bell company, which were invalidated by the decision in the Bate case rendered some months ago, opened the field to manufacturers of telephone instruments, allowing carbon to be used without infringing the patents. The situation is, however, somewhat complicated, and such a decision, although it might be used as an excuse for proceeding against alleged infringers cannot materially change the situation. Should the case be appealed, it will undoubtedly be some time before a decision is reached; possibly not before these patents have naturally expired in 1908, unless the case is considered of sufficient importance to give it a precedence over cases now on the calendar. How many of the instruments now on the market this decision will effect is difficult to determine until the exact scope of the patent shall be determined by the court.

In the meantime, however, in order to better defend their interests the various telephone companies have started a movement looking to the organization of an association which shall include all manufacturers of telephone instruments excepting the Bell company. A meeting has been called for this month at which the organization is to be perfected. The advantage which the Bell company has gained by a monopoly for so many years of the entire telephone industry makes such an organization necessary to better defend the interests of the younger companies. Such an organization will help to give the different companies a better understanding of telephone patents, concerning which the knowledge in general is quite limited. The large number of telephone patents, and the various decisions regarding them has tended to make it extremely difficult to determine the freedom of new companies in the design of telephone instruments and accessories. This association will afford a means of unraveling some of the complicated patents. It will also enable them to meet more effectually the promised attack of the old company upon all alleged infringers of their patents.

One cause of the deterioration in candle-power of incandescent lamps is the blackening of the interior of the globe. The minute particles that form a film over the interior of the globe prevent a considerable percentage of the light passing through the globe. Lamp makers have studied the subject, inventors have worked on it and users have speculated on the causes for the formation of this deposit. Many theories have been advanced but the real cause has not as yet been established. Manufacturers by changing the methods of manufacturing the filament have been able to reduce the amount of the deposit, but it is present in all lamps after a certain period of use to a greater or less extent. An examination of incandescent lamp filaments and blackened bulbs has been made by means of the microscope by G. Tolomei and the results published. He is now making a chemical examination of the deposit and filament which will undoubtedly add greatly to the present knowlege of the subject.

When examined under the microscope the unused filament has a regularly undulating surface. The surface of a used filament has little humps resembling in miniature those on the carbon of an arc lamp. They seem to have been produced by some melted material. In places the filament seems furrowed by transverse cavities out of which rise ramifications of lamp black. He notes the deposit to be deeper near the point of breakage and ascribes the breaking of the filament to the same cause as the blackening of the globe which is connected with the development of some gaseous substance from the carbon. The film under the microscope displays a very thin coating of lamp black in which are distinguished larger grains irregularly distributed and also yellowish crystals. From his observations the investigator offers the following explanation of the formation of this film: Certain mineral substances contained in the carbon becomes fused by the light temperature and owing to the evaporation of these substances, the carbon undergoes a gradual disintegration, some very minute particles of carbon being projected onto the glass. When the explosions of the little humps present on the surface are at all violent, entire fragments are detached and at those places where detachments occur most frequently, the filament breaks. This explanation, although possibly correct, does not agree with many that have been offered heretofore.

No enterprise of recent date has attracted more attention from engineers, railway men and the public in general than the Metropolitan West Side Elevated railroad, opened last month. It marks an epoch in the history of electric traction in America. The careful estimates made from data obtained from the Intramural at the World's Fair, by the engineers, of the comparative cost of operating the road by electricity and by steam locomotives showed a considerable difference in favor of electric traction. The annual report of the Liverpool electric elevated road has also been favorable to this method of rapid transit. The elevated roads of the future will undoubtedly be operated by electricity and existing roads are watching this road with a view to the substitution of electricity for present motive power if it proves on this road sufficiently economical. For cities covering large areas the elevated railway is unquestionably the most desirable rapid transit system. With no grade crossings, frequent stations at which passengers are taken on or let off, its block systems and safety devices which protect the passengers while being carried swiftly from station to station and a right of way unimpeded by street traffic or obstructions, it is the safest and most reliable system.

If to these advantages are added those of electric power with a central power station equipped with the most improved and economical machinery, a train equipment, starting and stopping quickly and smoothly as the motorman directs, the speed being at all times under his control, and the smoke, dust and noise of the locomotive absent, it becomes the most modern means of rapid transit and the most satisfactory for American cities. Electricity not only moves the trains, but lights, heats and indirectly stops the trains. It lends itself readily to all demands of the service, and permits of a control of the motion of the train unattained by any other form of power. The duties of the motorman are quickly learned and the expense of the steam road for engineman is reduced to about one-third with electric power. Other items of expense are reduced, but there is added the expense for maintenance and operation of power house. The results of six months or one year's operation will be awaited with great interest, since it will determine the economy of electric power in the operation of elevated railway trains. The description of the equipment of this road, which is extensively illustrated in this number, cannot fail to interest the reader.

Texas Gas and Electric Light Association.

The Texas Gas and Electric Light Association was organized at the meeting that was called at Houston, Texas, May 22. There were in attendance a large number of the directors, managers and superintendents of gas and electric companies of the state. The meeting was called to order by Mr. W. E. Holmes of the Austin Gas Light and Coal Company. Mr. Homer Starr, manager of the Gonzales Electric Light and Power Company, was elected temporary secretary. Mr. Holmes stated the object of the meeting, and a committee on permanent organization was then appointed, consisting of Messrs. Fuller of Calvert, Bauer of Texarkana, and Fitzgerald of Houston, and shortly after made the following report:

1. That we organize the Texas Gas and Eiectric Light Association.
2. We recommend that the following permanent officers be elected: A president, vice-president, secretary and treasurer combined, and an executive committee consisting of three members.
3. That our first president shall be Mr. W. E. Holmes of Austin; vice-president, Mr. P. Bauer of Texarkana; secretary and treasurer, Mr. Homer Star of Gonzales.

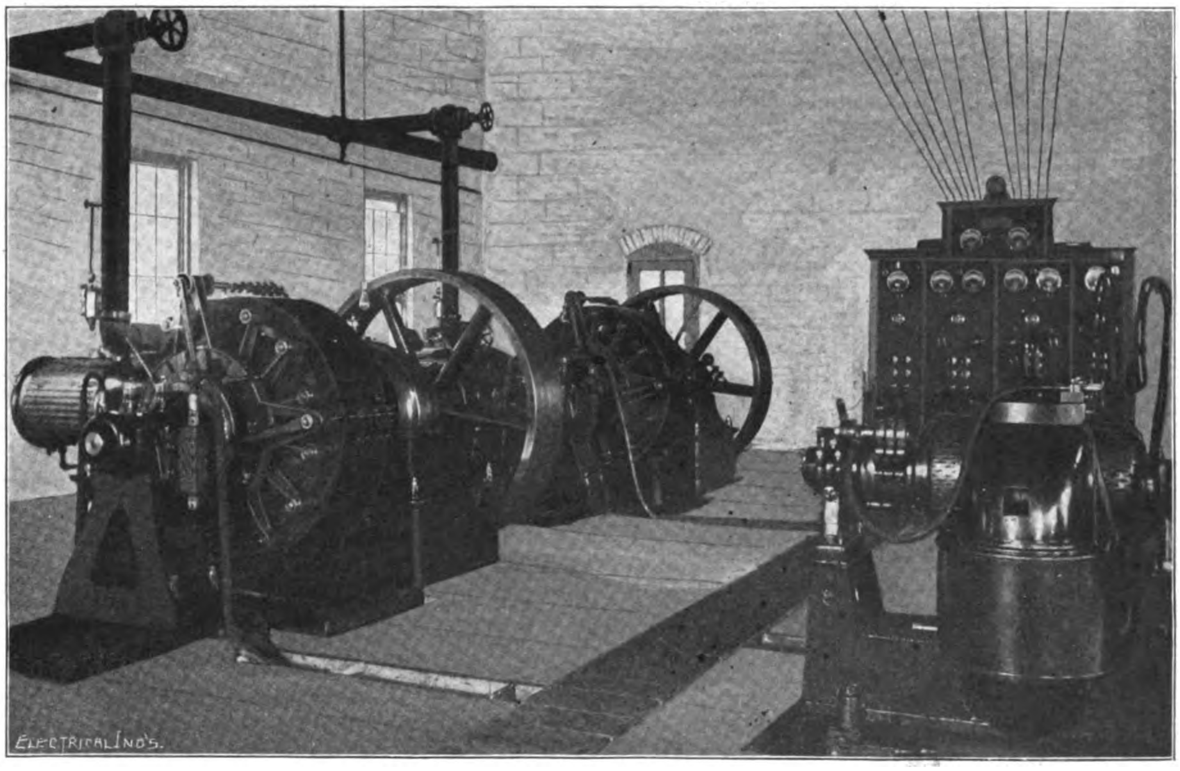
The report was adopted as read, and the committee was continued as a committee on constitution and by-laws. The following were elected members of the executive committee: Mr. C. D. Brann of Galveston and Mr. Thomas D. Miller of Dallas, for two years; Mr. Fuller of Calvert and Mr. Fitzgerald of Houston, for one year. Many items of interest were discussed. The next annual meeting will be held the second Tuesday in May, 1896.

Electric Lighting in Milwaukee.

Since the present contract of the city of Milwaukee with the Badger Illuminating Co. expires in December next, the subject of electric lighting is being thoroughly discussed. The subject of municipal lighting is receiving considerable attention. The question whether the city can furnish lights from its own plant cheaper than it can purchase same from a private company has been discussed in the Common Council. Manager Wyman of the Milwaukee Street Railway Co. recently presented a communication to the Common Council in which he presents many facts and figures which tend to show that lights could not be furnished by the city at so low a cost as obtained under the present contract with the Badger Illuminating Co. He reviews in his communication the various items of expenses; the cost of plant, the interest on the bonds, the cost of operation, insurance, taxes, depreciation, etc., dwelling especially on the latter, which is so commonly overlooked in the usual estimates of the cost of lighting by municipal plants. "Figure in all these items of expense," says Mr. Wyman, "and any unprejudiced man will say that it is impossible for the city to produce arc lights cheaper even than the rate which it is now paying. Mr. Benzenberg has figured the operating expenses too low, and he has done the same with the percentage of depreciation. He has figured the cost of repairs altogether too low and has omitted to figure taxes, insurance and office expenses. I am prepared to prove conclusively that at the present cost of lighting to the city, Milwaukee is getting its arc lights cheaper than any city in the country, in proportion to quality furnished and considering the underground construction. The importance of going more deeply into the cost of operating and management of an electric light plant can scarcely be exaggerated, and no city can afford to undertake the establishment of so expensive and far reaching an industry, until it knows the cost of every item going to make up the total unit cost of supplying the electric current to its people.

The Remodeled Lighting Plant at Oskaloosa, Ia.

During the latter part of the past year, Mr. W. A. McNeill, receiver of the Oskaloosa Edison Electric Light & Power Co., decided to remodel the plant, hoping by increasing the capacity and improving the equipment of the plant to place it on a paying basis. An increase of public as well as commercial lighting he was confident could be secured which would yield sufficient additional returns to give a profit on the investment. The number of lights furnished the city for lighting the streets was not sufficient to cover the city streets and there was opportunity for a large extension of commercial lighting. The old plant consisted of four 45-kilowatt direct current Edison machines, one 30-light T-H arc and one 30-light Ft. Wayne arc. Power was furnished by one engine of the saw-mill type which drove a line shaft beneath the floor of the dynamo room and an Ide of 125 horse-power, and an Armington & Sims of 60 horse-power belted to the arc dynamo. The Edison dynamos were belted through the floor to the shaft.



THE REMODELED LIGHTING PLANT AT OSKALOOSA, IA.

With a view to a better arrangement of the equipment and accommodations for an enlargement of the plant a new power station was commenced adjoining the old building. A contract was made with the Siemens & Halske Electric Company of America for two direct connected generators of the I type with a capacity of 126 kilowatts each. The engines were to be built by the Ball Engine Company of Erie, Pa. They were of the company's well-known type with simple cylinders 16 by 16, running non-condensing at 275 revolutions per minute. These engines are of the horizontal type, and both engine and dynamo are mounted on one foundation as shown in the accompanying engraving.

The new station was hardly completed when the old station took fire from an overheated bearing on the shaft beneath the floor. The amount of grease and oil with which the floor was saturated fed the flames and in a short time the station was consumed. The boiler house and new station, however, were saved. The electrical machinery was ruined, but the two smaller engines were taken out of the ruins and cleaned up for use. Mr. McNeill started for Chicago immediately after the fire, having first ordered the two engines set up in the new station building and connected to steam mains. Two machines of 380 amperes at 125 volts of the L H type were secured from the Siemens & Halske Electric Co. and shipped immediately. They reached Oskaloosa just a week after the fire, and in two days more the temporary plant was in operation. The direct connected sets were finished a few days after and reached Oskaloosa soon after the temporary plant had been started. Thus by the united efforts of the manufacturers and those connected with the lighting company the new power station was in operation in a remarkably short time considering the distance the machines were shipped.

The plant is now one of the most complete in the state, and is well arranged for efficient service. The two 800-light machines handle the day load and work well with the larger machines when there is more load than one can handle and not enough for the two. The station is equipped with all necessary devices. The switchboard has Weston instruments, Carpenter rheostats, improved ground detector which shows immediately the condition of the lines, etc. The pressure of a button throws the lines into circuit. The lamps, of which there are three, indicate the presence of a ground, and in different combinations indicate which side of the circuit is grounded. The system of distribution is the three wire system, and the center of the district lighted is at some distance from the station.

The direct connected machines form one of the more recent combinations which has been devised for electric lighting. The Ball engine is extensively used in the central stations of the United States, and its principal features are well-known to electric lighting men. It was designed for hard and continuous service. The governor effects a close regulation, an important point in every engine used in the generation of electricity. The construction of the governor is not complicated, having two weights and two counteracting springs, a third spring being attach at one end to the weight-arm, and the other end to the piston-rod of a dash pot. This dash pot forms a yielding base for the spring. When motion of the governor weights takes place, this supplemental spring is put under tension for the moment and gives stability to the governor, but the dash pot quickly releases the tension and the spring returns to its normal position. The engine is strongly built and rests on a substantial base. The crank shaft is made of steel. The valves have large openings which admit the steam rapidly to the cylinder and allow the exhaust to escape with the least friction. The Ball Engine Co. have made a specialty of engines for electric lighting plants.

The generators are of a type introduced comparatively recently in America, and have been described in previous numbers of Electrical Industries. They are of the external armature type, with commutator segments forming a section of the armature windings. The design is simple and all parts are easily repaired if such a thing becomes necessary. The combination is compact, efficient and strongly built. The Oskaloosa Edison Electric Light & Power Co. has now a modern plant in every respect and should yield the returns hoped for by its manager.

An Historic Sketch of the Atlantic Cable.

BY FRANK HALLENBECK.

The conveyance of electrical force in metallic conductors on land, after Morse accomplished his work, was a comparatively easy mechanical task, and to transmit this force through wires submerged in water for short distances, by means of waterproof insulation wiring, was also soon mastered. The question arose, if one can do this for a short distance, why can one not do it across the ocean? At all events it was decided that if venturesome people would advance the money, the effort would be made. The most eminent experts in mechanical and electrical science pronounced the task a feasible one. Never, perhaps, in the history of mankind was a proposal made to undertake a task involving greater scientific and mechanical difficulties. It required the indomitable perseverance of that wonderful organizer, Cyrus W. Field, who devoted his fortune and the money of many of his friends for many years, before this—one of the greatest feats of modern science -was accomplished. A fair commencement was made in talking and writing up the feasibility of the plan in 1850.

David Dudly Field *Prof. Morse.* *Cyrus Field*
Chandler White. *Daniel Huntington.* *Wilson G. Hunt.*

Peter Cooper. *Marshal O Roberts.* *Moses Taylor.*

MEMORIAL PICTURE OF ATLANTIC CABLE PIONEERS, PRESENTED TO THE NEW YORK CHAMBER OF COMMERCE.

However, it was not until the summer of 1857, when a fleet of four of the most powerful naval vessels, two of Great Britain, and two of the United States, sailed from the west coast of Ireland to America, freighted with this slender strand that was destined to link the old world with the new. The cable contained seven small copper wires for the electrical current. This copper core was carefully covered with a gutta percha insulating compound to retain the electricity and keep out the moisture. This again was covered with tarred hemp and all covered with light strands of iron wire. It was only about $\frac{5}{8}$ inch in diameter. (A specimen of the original cable I hold in my hand.) One-half of this cable was coiled up in immense coils in tanks, temporarily, prepared for it, in the United States Man of War, the steamer Niagara, and the other half in Her Majesty's war vessel, the steamer Agamemnon. Each of these vessels was accompanied by a sister vessel, the pick of the navy, to render any assistance in case of disabled machinery. About 1,500 United States and British naval officers and sailors were engaged in this enterprise.

The eyes of all the nations of the civilized world were centered on the grand experiment. The Niagara's cable was to be laid first and then in mid-ocean the Agamemnon's part was to be spliced and she was to finish the task. When nearly 400 miles was successfully laid, the cable parted and every effort failed to pick it up from its watery bed, almost two miles deep. In 1858 the attempt was again made and after many difficulties were overcome, the cable was laid and about 700 messages were sent through the line. It worked so inefficiently that the line was never open to the public, and after a few weeks the power of the cable to transmit electrical energy was lost. It was a dead cable. Thus matters stood for seven long years, after spending many millions of dollars and receiving the liberal assistance of the two governments, Great Britain and the United States. However, in 1865, after we got through with the War of the Rebellion, the same parties, with the aid of Great Britain, with plucky John Bull and Brother Jonathan again linking hands in power and brain, a new cable, much stronger, was prepared. It was laid nearly across the Atlantic, but was broken in the deep sea and could not be picked up. Nothing daunted, another cable was manufactured and safely laid July 17th, 1866, nine years after the first attempt. There are now ten trans-Atlantic cables, and thousands of miles of submarine cable connecting the various parts of the earth. The Pacific is yet to be spanned, and preparations are now being made for this task.

During a blizzard a short time ago, when all the lines between New York and Boston were in-operative, urgent news for Boston was cabled from New York to London and then back across the Atlantic to Boston. A message, by the means of cable and land, can be sent from Australia to California (a distance of 18,600 miles) in less than one hour.

On the 12th of November, 1882, a banquet was held in London and another in Adelaide, Australia, by the persons interested in the trans-Australian line. At the opening of the banquet a congratulatory message was sent to Australia and at the close of the banquet a reply was received ending with: "Hurrah!"

At the opening of the Melbourne expedition a message was sent to the Queen of England, consisting of sixty-six words, and took but thirty-eight minutes to be transmitted —a distance of 10,000 miles.

Another example of rapid transmission is that of a message being sent from London to Sydney. It was sent direct from London to Singapore when it was repeated, being transmitted from there on the trans-Australian cable. The distance from Singapore to Sydney is 5,070 miles and the time taken was but thirty-five seconds.

These great results have been achieved in the past thirty years by the genius of the preceding generation, and the foundations laid by our fathers are but the indications of the possibilities that await us in the years to come. The inventor, the promotor and the far-seeing capitalist are ever ready to increase the benefits of the human race.

Whatever may be the motives, the results to civilization are far-reaching. Columbus discovered America, but the genius of our age has bridged the sea and moved the nations of the earth side by side.—Read at the Zig-Zag Club.

Lightning Arresters and Why They Sometimes Fail.

BY ALEXANDER J. WURTS.

The lightning arrester of today, as a protective device, differs from the lightning arrester of the early telegraph in detail only. A simple spark gap, one terminal of which is connected to the line and the other to earth, is essentially the lightning arrester now in use. But, with the modern high potential circuits it is found that the dynamo current follows the static discharge across the spark gap of the arrester, causing thereby a short circuit or dangerous ground on the line. In order to avoid this difficulty arc rupturing devices are attached to the lightning arrester, which have for their function the immediate interruption of the dynamo current, without interfering with the further operation of the lightning arrester as a discharging device. "Automatic lightning arresters," as they are called, differ among one another in the various means adopted for rupturing the dynamo arc. But the arc rupturing attachment has nothing whatever to do with the apparatus as a lightning arrester, so that although automatic lightning arresters vary in outward appearance and are in general more cumbersome and expensive than the original simple spark gap arrester, yet, as a lightning arrester, they are nothing more than spark gaps. Various lightning arrester attachments have been designed for the automatic rupture of dynamo arcs, but owing to the very high potentials which are so often used, these are found to be not only undesirable, but inefficient, the lightning arresters being frequently destroyed by the vicious dynamo arc.

In practice, however, complaints are not so much that lightning arresters are destroyed as that they "fail to protect." It is not infrequent to see several different kinds or makes of lightning arresters in a single station, which have evidently been installed with the idea of determining which one of these would prove most efficient. But such experiments have met with disappointment, for the reason that sometimes one lightning arrester would receive the discharge, sometimes another, and the selective character of disruptive discharges was not understood. The failure of lightning arresters is not due to the particular kind of lightning arrester or to the patent under which it is manufactured; it is due largely to the peculiar circumstances with which it has to contend, namely, that the discharge is selective, and that, in order to protect apparatus, means must be taken to control these selections,or at least,to provide so many paths to earth that the probable selection will be one of the many paths provided. In other words, lightning arresters do not" protect;" they simply offer opportunities for discharge. These opportunities may or may not be embraced, according to circumstances. But the failure of lightning arresters is not altogether due to the peculiar conditions already referred to. Poor ground connection, inductive resistance in the ground circuit, defective insulation in the apparatus to be protected, and a general misunderstanding of the subject, are not infrequently the cause of serious losses which might otherwise have been avoided.

We have noticed that lightning arresters do not "protect," that they simply offer opportunities for discharge. We have also noticed that discharges do not pass readily through coils of wire—coils therefore protect. Properly constructed choke coils connected in the circuit offer a high resistance to the passage of disruptive discharges, and when used in connection with lightning arresters the combination offers a very reliable means of protecting well insulated apparatus against lightning. Laboratory experiments, together with tests made under actual working conditions, indicate the advisability of using four choke coils in series, in each wire, with four lightning arresters intervening. This arrangement is more particularly suitable for the protection of station apparatus. Coils can, however, be used to advantage on the line for the protection of the more expensive translating devices.

The general construction of the choke coil is a matter of considerable importance. A flat spiral possesses some advantages over the helix, but for practical purposes these hardly compensate for the lower cost of the latter. which, for best results should be wound over a wooden or other nonconducting core. Metal cores and cases should be avoided, because the induced currents in these parts would lower the choking effect of the coils. The number of turns which can be used to advantage is limited. It is found by experiment that with given conditions the choking effect increases with the number of turns up to a well defined point, after which additional turns fail to have any appreciable effect. It is probable that these critical points vary with the amount of electricity discharged, that is, for heavy discharges the critical point for maximum choking effect would embrace a larger number of turns than would smaller discharges, and the choking effect for a given number of turns within the critical point would also be greater for heavy discharges than for small. For practical purposes the writer recommends from 40 to 50 feet of wire wound either into a flat spiral having an internal diameter of three inches, or into a three inch helix with a single layer.

Summing up once more, we note that wires become charged, lightning arresters offer opportunities for discharge, and coils protect. Bearing these three points in mind, let us note that, with the extensive systems of electric light and power distribution now in use, it would be quite impractical to install the above described system of choke coils and lightning arresters for the protection of each separate piece of apparatus. The first cost of such an installation would be prohibitive. It is evident, therefore, that, not being able to protect line apparatus with choke coils, there remains but one alternative, namely, that of providing such a large number of opportunities for discharge, distributed over the entire system, that the selection of the discharge will be one or more of the paths provided for it. In other words, line arresters connected at frequent intervals offer the only practical method of protecting widely distributed apparatus. But, in order that such an installation may prove satisfactory from a commercial as well as an operative standpoint, the arresters must be cheap, simple, free from moving parts and perfectly reliable without the necessity of regular inspection.

The failure of lightning arresters is too often due to careless installation. It may be instructive to note several examples:

(1.) One plant is reported as having, for better protection, connected two arresters in series. This was probably done with the idea that if a little was good more would be better.

(2.) A large bank of station arresters was grounded to an iron bolt, about two feet long, driven into dry sand.

(3.) Line arresters were grounded by pushing the ground wires into the earth.

(4.) Line arresters were grounded on iron poles, which were themselves set in Portland cement.

(5.) An annual inspection of automatic lightning arresters developed the fact that the arresters were nearly all burned out—in other words, that the line was left unprotected.

(6.) The ground plate of a bank of arresters was thrown into a neighboring stream, which subsequently changed its course, leaving the ground plate high and dry.

(7.) The ground plate of a bank of station arresters was laid on the rock bottom of a neighboring stream.

(8.) In a large number of cases a portion of the ground wire is wound into a fancy coil (choke coil).

And so on, the list might be indefinitely extended, each subh case forming a source of complaint that the arresters "fail to protect." But, when these curious mistakes are located and properly remedied the complaints cease.—Abstract of article in Practical Science.

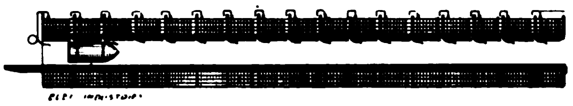
The Electricity Building of the Cotton States & International Exposition at Atlanta, Ga., has just been completed. The pleasant weather the past few weeks has enabled the work to be pushed forward very rapidly. It is expected that this building will be one of the first ones ready with its exhibits for the opening.

John Kean has been appointed receiver of the Woolf Electric Disinfecting Co., of New York, Charles E. Chapin, dealer in electrical supplies at 136 Liberty St., New York, has assigned to John K. Creevey.

An Electric Gun.

There was recently exhibited at Springfield, Ohio, an electric gun which attracted a considerable attention. It is certainly a very interesting invention, although its inventor claims no great practical value for it. The gun barrel or tube used at this exhibition was about three feet long and fired a projectile one and one-quarter inches long and five-sixteenths of an inch in diameter. A metal target was set up and the gun resting on a support was aimed at it. The projectiles were inserted at the breech and struck the metal target with considerable force. With shorter projectiles the gun can be fired almost as rapidly as the bullets can be inserted.

The construction of the gun is illustrated in the accompanying diagram. The tube is wound with coils of wire, each coil being about three-quarters of an inch long. Each coil has an open circuit except where the small springs, indicated, are pressed up. On the gun exhibited there were forty separate coils. The gun was connected to the street railway circuit. When the projectile was inserted it closed the circuit of the first solenoid and was drawn in by it, passing the next spring contact and releasing the first spring. The projectile, therefore, throws the solenoid ahead of it into circuit and those behind it out. It is all the time being pulled ahead and when it has reached the end has gained sufficient momentum to carry it a considerable distance.



AN ELECTRIC GUN.

While it may not be of great practical value as an arm, Mr. A. S. Krotz, the inventor, suggests that the principle might be valuable if applied in a system similar to the pneumatic systems for carrying small packages, mail matter, etc. The speed that might be obtained would be almost unlimited. Mr. Krotz is the chief engineer of the Springfield railway power house and instructor on electricity at the Y. M. C. A. He has taken out patents on a number of electrical appliances.

The Jeantaud Electric Carriage.

Self-propelling carriages have been the study of inventors for many generations, but up to the present time none has been produced which has possessed sufficient merit for its adoption in preference to the carriage drawn by horses. Electricity from storage batteries is believed by many to possess the necessary qualities for driving such vehicles. Carriages so propelled have been seen at times in many of the large cities, but from one cause or another have been quietly withdrawn. Other inventors, undeterred by previous failures, have carried forward the work in this line, and have overcome many of the difficulties encountered in former carriages.

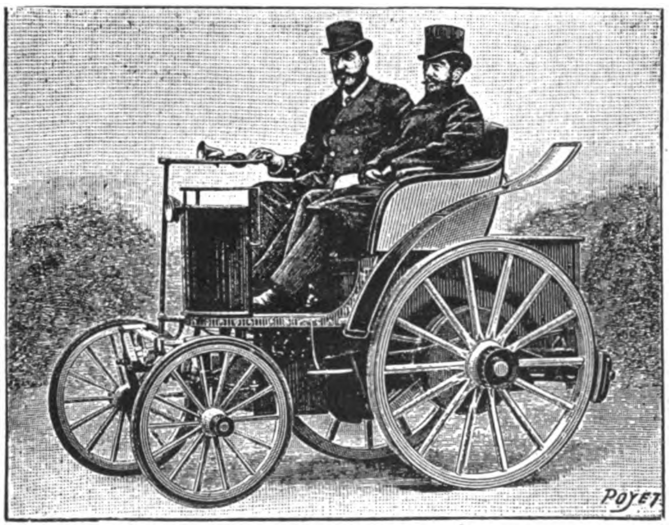


FIG. 1.—THE JEANTAUD ELECTRIC CARRIAGE.

The carriage, illustrated herewith, is the invention of Mr. Jeantaud, a carriage builder of Paris, who understands not only the construction of the carriage itself, but has made a long study of the motor power. The carriage has been tried on the streets of Paris, and has also been granted a permit to run about the city. It has made successful runs over macadamized roads of 18 miles. The carriage is a four-wheel phaeton, well constructed with a view to electric propulsion. It accommodates two persons. A considerable space is necessary for the accumulators and electric motor and connecting apparatus.

The battery is composed of 21 elements, located in seven boxes containing three each, and weighs, including boxes 925 pounds. At a discharge rate of 30 amperes its capacity is 300 ampere hours, and at 40 ampere discharge the capacity is 240 ampere hours. The motor is series wound of about two and a half horse-power. It is suspended from the carriage box by flat springs, which deaden the jar in passing obstructions or in starting or stopping the motor.

The connection of the motor shaft to the wheels is shown in Fig. 2. As will be noticed it is made without chains, which are so often employed. The connection is effected through the intermedium of a shaft revolving in two pillow blocks fixed to the axle and carrying at its two extremities two pinions engaging with two drums toothed internally. These drums are fixed to the hubs of the carriages. The shaft carries a gear which is controlled by the pinion on the motor. The suspension of the motor is such that the teeth of the pinion will always mesh with the teeth of the gear on the shaft.

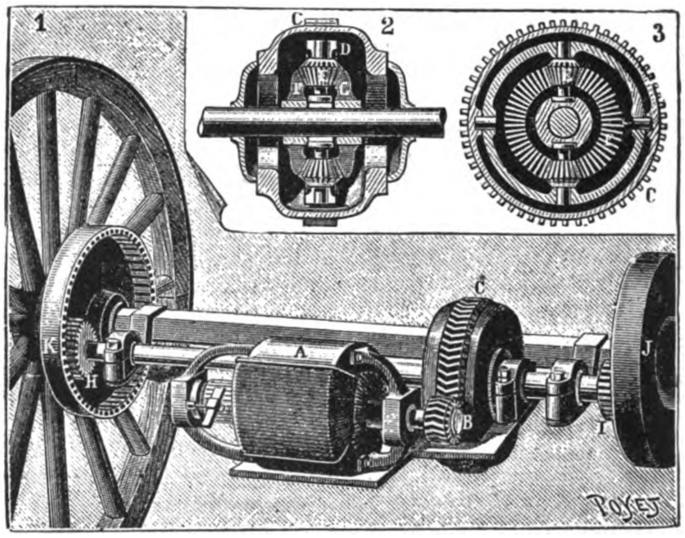


FIG. 2.—THE JEANTAUD ELECTRIC CARRIAGE.

The apparatus for the control of the driving mechanism of the carriage is most conveniently located. The steering handle is placed where it is in easy reach of the passenger's hand. In the front of the carriage there is a pedal that controls the circuit breaker and the brake. This is operated by the driver's foot. The brake strap winds on the hub of the wheel and draws the wooden block to bear against the tire. The current is cut off before the brake is applied by the pressure on this pedal. The total weight of the carriage, equipped and carrying two passengers, is 2,500 pounds. Twelve miles an hour is easily accomplished. The carriage is strong, simple in construction, and is easily operated. The cuts are from La Nature.

"There is not a better paper printed on electrical subjects in North America or all of them put together than Electrical Industries for a young man to read. Most everybody can understand it. Many others say the same. Now, do not think I like to brag, but it's just the plain truth and I wish to let you know it." F. DeWilde.

Chicago, Ill., May 28.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Currents of Electricity.

When a difference of potential exists in two places connected by a conductor, or a series of conducting bodies, the electricity will seek to equalize the field and a current will flow between the two points. The difference of potential may be due to several causes, but whatever the cause the current will flow. The two places may be a few inches apart, as in a wire from a primary battery, or miles apart, as in a transmission system, or in the currents of the earth or air. They may be connected by a small copper wire, the pipes of the waterworks or gas company, the rails of a street railway, or by a combination of a large number of conducting bodies. This conductor may be of large capacity, of low resistance, or may be a poor conducting medium.

To designate the character of a current, and also a current with reference to its origin, various terms are used. Battery current, dynamo current, earth current, etc., are terms used to designate the current from a battery, a dynamo, currents flowing through the earth on account of a difference of potential at different points, etc. In the production of electricity for lighting and power two kinds of current are generated, distinguished by the direction in which they flow. The continuous or direct current which flows continuously in one direction, and the alternating or reversed current, which alternates the direction of its flow, are the currents used, and these two kinds include a number of classes. Both currents are further designated by the voltage; thus we have a 500 volt direct current, 110 volt alternating current, or any other volt direct or alternating current.

The alternating current may alternate the direction in which it flows ten thousand times a second, or twenty-five times a second; this is called the frequency of its alternations. The alternating currents are also distinguished by the number of phases in a given period. When alternating currents are generated by transmission considerable distances, so that a current of higher voltage is used on the transmission lines than can be used for lighting and other purposes the transformer is used for securing a current of higher or lower voltage. The current flowing in the primary wire of the transformer is called the primary current, and that in the secondary wire the secondary current.

A constant current is an unvarying current. Although the voltage may vary the amount of current does not change. In series arc lighting systems the current is universally constant. A constant potential current is a current whose voltage is constant, as found in the multiple incandescent lighting system.

INDUCTION OR INDUCED CURRENTS.

One of the great discoveries made by Faraday was that of induction or induced currents. While experimenting with electricity and magnetism he found that if he took a wire joined the ends and moved it rapidly in front of a magnet, a current would be induced in the wire. This action of the magnet is called electro magnetic induction. The current is called the induction or induced current and it is upon this principle discovered by Faraday that all dynamo electric machinery is based. If we take a coil of wire and a bar magnet and pass the magnet rapidly through the coil a current will be induced in the coil, or if we move the magnet into the coil and then withdraw it we will have a current flowing first in one direction and as we withdraw it in the other. The more rapid the motion the stronger the current.

This discovery was soon followed by another of equal importance—that a current of electricity whose strength is changing in one conductor could induce a current in another conductor forming a closed circuit and that a current brought near a conductor and then removed would induce a current in the second conductor. Suppose we have two coils of wire, the terminals of one connected to the terminals of a primary battery and the terminals of the second connected to a galvanometer. If these coils are placed near together with a battery current flowing through the first there will be no current detected in the second. If, however, we place a switch in the circuit of the first and open and close it rapidly the galvanometer will show a current in the second coil. If we close the switch and make the coil approach and recede from the second coil, the second coil will have an induced current. Upon this principle are based the alternating current transformer and similar devices.

Storage Batteries and their Construction—IV.

BY J. K. PUMPELLY.

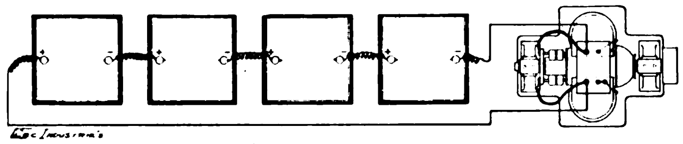
To describe in this one article the many and varied styles of storage batteries that have been made and put on the market since 1881, would fill a large volume. Even Park Benjamin's admirable work entitled the "Voltaic Pile" as exhaustive as it is, especially in describing the different forms and makes of the accumulator, does not complete the list down to the present year. The number of tried and successful batteries can today be counted on the fingers of one hand. Since the electro-chemical action is almost the same in every storage battery that has proven practical, we will suppose that we are now dealing with a battery plant, and will give some directions how it should be handled. When this point is well understood by the engineer who may take charge of the plant, we may go more minutely into the make of different batteries, and the causes of their failures.

We will suppose that a battery plant has been installed by the manufacturer to perform a certain amount and kind of work. In this case the work is to sustain at full candle-power, 30 incandescent lamps for ten hours. The lamps are of 110 volts, 16 candle-power, and the batteries are guaranteed to do this work. The batteries are supposed to have been properly installed, on strong racks well insulated from ground and moisture by the manufacturer, who should know by experience the proper method. The number of cells is 55, which furnishes an electromotive force of 110 volts and a current of 15 amperes per hour, for ten hours. It would demand of the cells a capacity of 150 ampere hours. The guarantee on such an instalment will be given on condition that certain directions are strictly followed in charging and discharging the batteries. In order to have the importance of the directions followed out we will explain in a few words why it is necessary. As this responsibility and care generally falls on the engineer who is running the plant, we will try to make our explanation clear.

We are supposed to have a set of batteries, 55 in number set up in series, that is, the position pole of each cell is connected to the negative pole of the next cell and the negative pole to the positive of the next, and so on until all are connected, thus leaving at one end of the series a position terminal to be connected by wire to the positive pole of the dynamo and a negative terminal to be connected in the same way to the negative pole of the dynamo. The manufacturer has done everything for us, except charging the batteries. Supposing that our dynamo is of voltage enough to do the charging of 55 cells. Now if the dynamo is run for no other purpose than to charge the batteries, we can gain more than 110 volts by speeding up the machine; we will suppose this is this case. It is, however, unusual and not an economical plan. The directions are to charge the 55 batteries with a current of at least 15 amperes for ten hours, or at not more than 20 amperes for 8 hours. To charge the battery at all we need an electromotive force of at least 132 volts. The reason that this greater electromotive force is required is briefly explained as follows: A storage battery cell properly formed has within itself a potential difference of 2 volts, and thus 55 of these cells connected up in series would show an electromotive force or voltage of 55 times 2 or 110 volts. If the dynamo can generate an electromotive force of only 110 volts, the energy of the battery and that of the dynamo will be the same and no current will flow into the battery. We might as well attempt to force water upward when the pumping engine can only develop a lifting horse-power equal to lifting a column of water to the present height. To fill the tank or receptical from which it is to be used, an overflow is necessary, of a few inches higher.

If we could overcome this difficulty by gaining a few more volts of pressure so that the dynamo develops 112 volts instead of 110, we could not charge the battery, but slightly, because experience has shown us that the moment the current begins to flow into the battery, electrolysis takes place, the cells begin to have an electromotive force of their own. As chemical changes go on the batteries develop a counter electromotive force powerful enough to overcome that of the dynamo, and the source of energy is actually reversed. The dynamo instead of charging the batteries is being run as a motor by the batteries. What are we to do in such a case? It is very evident that the voltage of the dynamo must be increased; to what extent, experience rather than calculation teaches us. We have found that when a battery is fully charged, it shows, at the moment when the current is cut off, an electromotive force of two volts and four-tenths of a volt, hence we must calculate on the dynamo's being able to generate an electromotive force equal to 55 times 2.4 instead of 55 times 2. Now 55 times 2.4 is equal to 132 volts.

As before noted, when the usual 110 volt dynamos, generating a current of 25 or 20 amperes is used for charging the batteries only, and no lamps are on the direct circuit to be destroyed by an increased electrical pressure, the dynamo can be speeded up to the required voltage. Since in a shunt dynamo, the kind generally used for this work, the voltage is directly proportional to the square of the revolutions, we can connect to a shunt dynamo, increase its speed to give current of 135 volts, which will be of a sufficient pressure to charge the batteries. Thus being in working shape it is a very simple matter to follow out the directions given, that is to charge with a current of not more than 20 amperes for eight hours, or less than 15 amperes for 10 hours. Since the battery is made for a capacity of 150 amperes, it is readily seen that a constant current of 15 amperes for ten hours will, as we might say in unscientific language, "fill" the battery.


BATTERIES IN SERIES.

The carrying out of these directions insisted on by the parties who may have sold and installed the plant, is not only fair to them, but to the benefit of the purchaser, since we could not expect to take 150 ampere hours out of a battery, if we had put but half of that quantity in it. We are forced to use other than technical language here, such as the words, "filling the battery," because, the daily use of a battery plant, appears much like the use of any other mechanically stored up source of energy to be used at some future time. Actually we do not store up electricity in the battery, nor do we fill it with energy, although we draw from it, as we would from filled tanks of water or from cylinders of compressed air. Indeed the process of pumping water into recepticles at a certain height and drawing from below is very similar to this charging of batteries by a dynamo representing an electric pump and then drawing from the battery an electric current to do work. The height at which the water tank may be above the point where power is to be applied in the discharge represents pressure in foot pounds, as the number of cells connected up in series, a measure of electromotive force, and the more economically we draw the water from the tank, the longer the pressure to do work lasts. The smaller the electric current in amperes per hour we draw from the batteries, the longer they will do work. Experience has taught us that a battery discharged at an ampere current of 10 per cent of the known capacity of the battery is the most economical discharge, by which we gain the longest sustained voltage and the most equally distributed work. The same rule holds good in drawing from any source of stored energy.

The directions for discharging a battery of 55 cells for lighting purpose with a dynamo fitted for this purpose alone is the simplest method of charging, but as I said before, seldom used. Because, as a general thing, batteries are installed as an aid to a dynamo plant, and it is expected that which a greater number of lamps than the battery would sustain are being lighted from the dynamo at the same time the batteries are being charged from the surplus current generated. In this case the use of batteries are economical, because the extra current generated by a dynamo which is running at full speed and still not carrying its full load, is saved or stored up, and can be made useful in carrying a smaller number of lights at night, after the dynamo is shut down. In fact it would not pay to run the dynamo all night for the sake of burning a few necessary lights. Now, the charging of batteries from a generator which is at the same time carrying a large number of 110 volt 16 candle-power lamps, is quite a different matter from the process just explained, as the reader who has followed my explanation can see for himself. In this, the lamps are made to bear an electromotive force of 110 volts and no more. Now if the dynamo should be speeded up as suggested before, in order to charge 55 cells, the lamps on the circuit would be forced above their capacity and at 132 volts be burned out. If the cells are reduced in number sufficient to be charged with 110 volts then they would not sustain these same lamps at candle-power after the dynamo was shut down. The directions for meeting this condition of things, which, by the way is the usual one when batteries are installed as aids to a lighting plant, must be reserved for a subsequent article.

University of Wisconsin.

Prof. Elisha Gray recently lectured before the department of engineering, University of Wisconsin, on inventors and inventing. Regarding inventors he said: "Like the poet, the inventor is born not made, but genius is principally hard work. There must be natural capacity, but this alone is not enough. There are four classes of inventors. In the first class is the man who has the creative faculty, the lively imagination of the poet, the painter or the sculptor. He discovers and then applies some fundamental principle of science. Such a man arises perhaps once in a century, and from his fundamental discovery grow thousands of inventions of less importance. The inventor of the second class has the power of combination. He is like the mechanic who manipulates, but does not dig the ore. The third class is composed of those whose inventions are of minor value, churns, rat-traps, etc. The fourth class is filled by the man who does not invent, but thinks he does."

E. A. Marsh has been appointed receiver of the Proctor Raymond Electric Co., Rochester, N. Y.

The patents of the Waddell-Entz Electric Company have been ordered sold by the court. The receivers have been unable to arrange the affairs so that the company could be reorganized or the business continued with any advantage to stockholders or creditors.

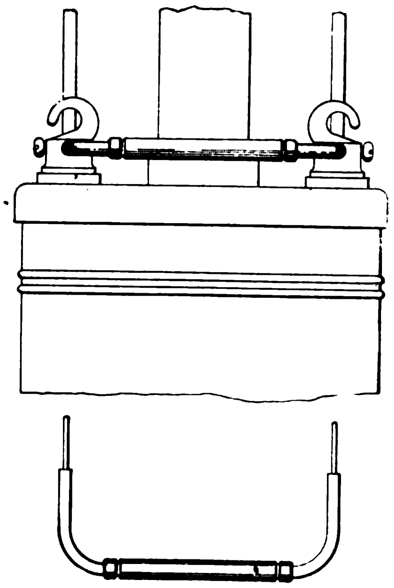
The re-building of the lines of the North Chicago Street Railway Co. has progressed very rapidly. The electric cars are now running on several of the north side lines which run to the business district. The trolley is used as far as Lake St., at which point horse-power is substituted, which draws the cars to the end of the line and brings them back to this point again, where the trolley is again raised.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

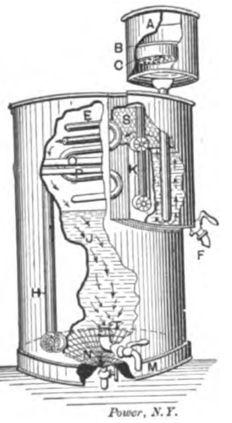
Fusible Shunt for Arc Lamps.

It frequently happens that through failure of the cut-out to work that arc lamps are burned out. The lamp becomes blocked with dirt or grounded by moisture and if the cut-out does not work, the lamp is severely damaged. A second protection for arc lamps has recently been devised by Nutting & Luce, of 197 Canal St., Chicago, in the shape of a fusible shunt. It is a simple device that by very accurate tests has been constructed so that an extra pressure makes a bridge of the shunt and passes directly from one binding post to another without passing through the lamp. It is intended to furnish a new path, instantaneously, for the current whenever the arc is strained above the point where the cut-out should work, and below the point where the current would be likely to jump the ordinary insulation of the lamp. The shunt is not in circuit until such an excessive pressure occurs that it is fused. It is always ready for action, and when used is thrown away and a new one inserted like the fuse in a cut-out. They are not expensive and when placed on a lamp are always ready to act.


FUSIBLE SHUNT FOR ARC LAMPS.

The Columbus Radiator Oil Purifier

The accompanying cut shows the radiator oil purifier which is placed on the market by the Columbus Radiator Oil Purifier Mfrs., Columbus, O. It was designed and patented by Mr. T. A. Nusbaum and has been in use in a large number of plants during the two years since it was brought out. The course of the oil through the purifier is shown by the arrows. The different parts specially constructed for filtering and purifying the oil are indicated by the letters. Thus in the receiver A their is a removable perforated screen, B, and a permanent wire guaze screen, C. Between these two there is a layer of waste which can be removed when dirty. From this receiver the oil passes through the water chamber. It descends through the pipe and rises through the water to the top where it passes through the screen box, S. Separating the upper from the lower part is a specially constructed filter through which the oil heated by the radiator between the oil and water chambers, is freed from the last traces of impurities. The work of each part is thorough and effective. So confident are the makers that the purifiers will give satisfaction in any plant that they are sent on trial for thirty days.

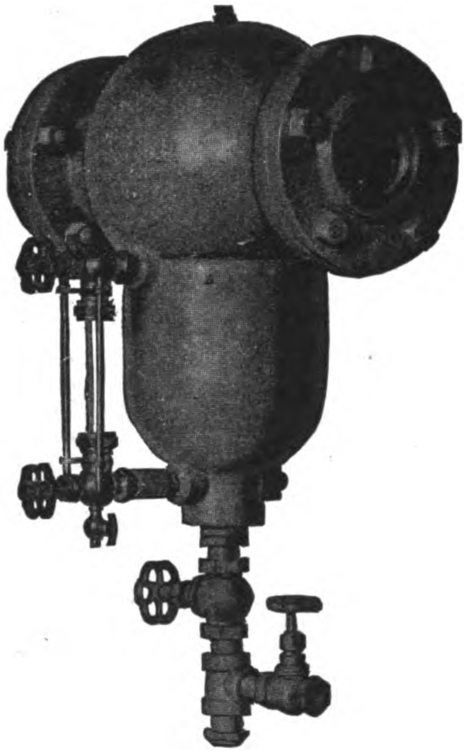


Power, N.Y.

COLUMBUS RADIATOR OIL PURIFIER.

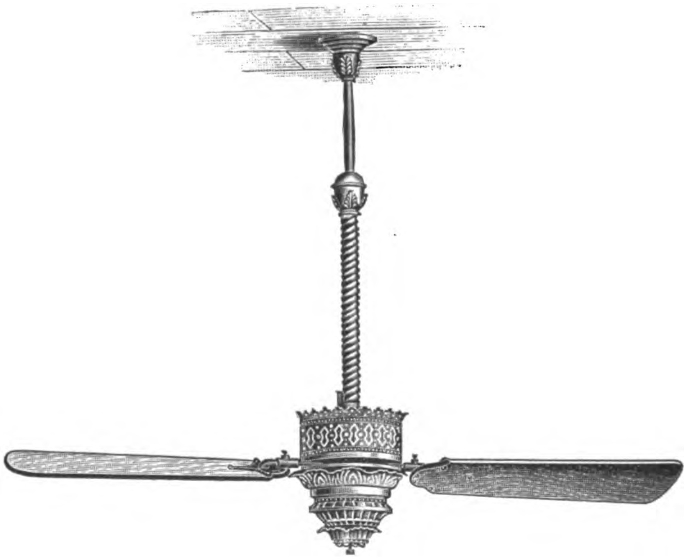
The Stuart Extractor.

The competition in manufactured products is so active that it is incumbent upon every architect and contractor to so design and construct new equipments as to show positive evidence of efficiency and economy in operating, and upon every superintendent or manager to so alter their plants as to reduce to a minimum the operating expenses. The illustration given herewith is of the Stuart grease and dirty water extractor, which, when used in connection with condensers, enables all the water of condensation to be returned to the boiler free from oil and dirt and at a high temperature. The economy of this arrangement is evident as it reduces the water-tax, by saving the water of condensation, reduces the fuel bill by furnishing hot and pure water to the boiler, and saves boiler repairs by taking grease and foreign matter out of the water of condensation. The valves and other parts of the steam system are not clogged by foreign matter. The arrangement of the baffle plates in the Stuart extractor is such that every atom of steam must come in contact with the plates. The oil and water falls into the receiving chamber by gravity and is carried off. The oil and water in the receiving chamber do not come in contact with the steam in circulation. A catalogue may be obtained by addressing the New England Engineering Co., Old Colony Building, Chicago.


THE STUART EXTRACTOR.

Electric Ceiling Fan for Alternating Currents.

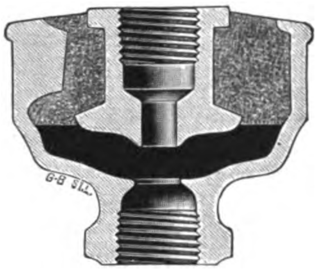
The electric fans manufactured by the Emerson Mfg. Co., of St. Louis, for whom the Electric Appliance Co., 242 Madison St., Chicago, is general western agent, have been for several years on the market. This season a new ceiling fan, illustrated in the accompanying cut, has been brought out designed for use on alternating current circuits. It is


ELECTRIC CEILING FAN FOR ALTERNATING FAN.

slow speed, 140 to 150 revolutions per minute, and will be found preferable, in many cases, to the small, high-speed fans. It is finished in a variety of styles, nickled, oxydized copper or polished brass. The motor is of the Meston type, which is well known to the trade.

The Interstate Insulating Joint.

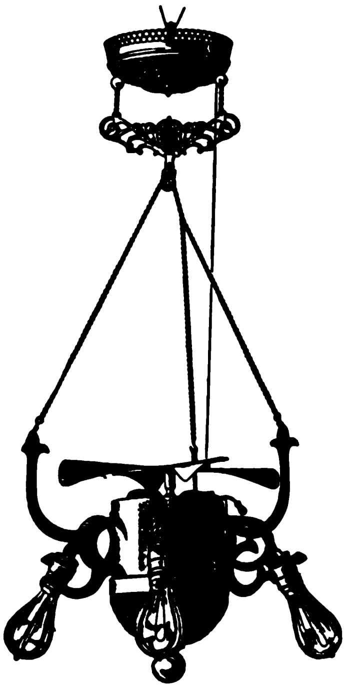
The accompanying cut shows a cross section of the Interstate insulating joint for combination gas and electric fixtures. It is manufactured by the Interstate Complete Electric Construction Co., of 813 So. Seventh St., St. Louis, Mo. The construction of the joint combines great strength with high insulating qualities. The homogeneous insulating material is introduced in the space in a plastic condition by hydraulic pressure and is afterwards chemically treated, causing it to set very hard. This material is non-absorbent and not affected by heat or gas. The shape of the annular chamber and drip, effectually prevents the moisture that may be in the pipe from collecting in the joint. The design of the different parts is such that the joint will not be loosened or injured with any twisting, pulling or crushing strain that may be put upon it in use.



INTERSTATE INSULATING JOINT.

The Molyneux Combination Electric Fan and Chandelier.

Among the most prominent of the productions of the Molyneux Electric Mfg. Co., Buffalo, N. Y., is a combination chandelier. Briefly described, it is a chandelier for electric incandescent lights, in the centre of which is ingeniously constructed an electric motor, and attached to this motor is a fan; the chandelier is suspended by chains, so devised that the chandelier can be posed at will, to any desired position, receiving from it not only the illumination of the incandescent lights, but the cool, refreshing effects of the fan. For winter use the chandelier can without any trouble be so posed as to fan the heat out of one room into the one above. The chandelier is of an elegant design, and the motor is so enclosed as not to be at all discernible, the whole is a most neat and compactly arranged article and the light and fan power are obtained from the same circuit. This combination is decidedly new and will undoubtedly be favorably received by the public. The motor is wound to be used on 110 or 220 direct current or on 52 or 104 volt alternating current. It is noiseless in operation, a fact which makes it most desirable for residences, the sick room, etc. It requires little care. If oiled when started it needs no further attention through the season. The method in which it is suspended enables the fan to be turned in any direction, giving the breeze in the direction desired. It can also be raised and lowered as a suspended lamp. It can be used simply as a chandelier or as both a chandelier and fan.

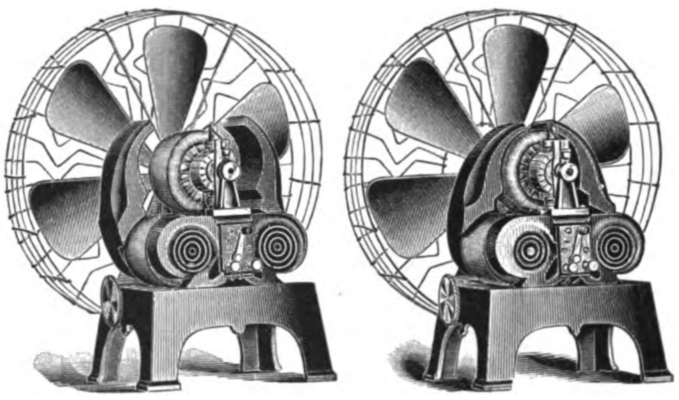


The "Parmelefan."

The McLean Armature Company of Chicago is manufacturing a new fan motor of a very substantial and novel type. The name Parmelefan, which sounds very much like Palm leaf fan, is a combination of John S. Parmele's name, the secretary of the company.

The novel feature is the regulation of the speed, which easily ranges between several hundred revolutions up to fifteen or eighteen hundred. This is accomplished without the aid of any artificial resistance or change in the field connections.

The principle is merely the change in the relation of the fields to the armature, which is adjustable by means of a screw on the side. One illustration shows the motor with the field open at a point of minimum speed; the other shows the fields closed and at a point of maximum speed.

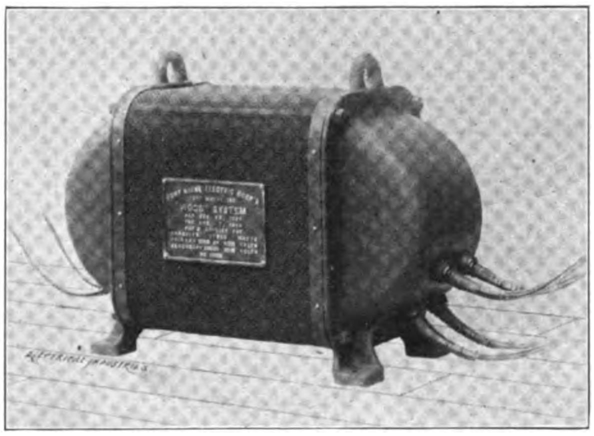


FIGS. 1 AND 2.—THE "PARMELEFAN."

The motor is fitted up with fan and guard, oil cups, rubber tips for the legs, and is neatly finished; the brushes are self-adjusting and of carbon. The Parmelefan bids fair to meet with favor and the euphonious name seems well chosen.

The Fort Wayne Electric Corporation's New 750-Light Transformer.

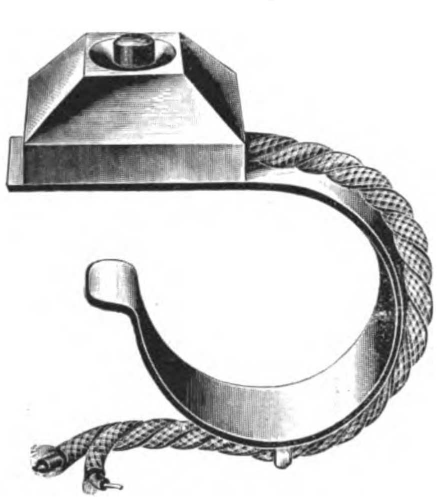
The accompanying illustration represents a new type 37½-kilowatt transformer designed by Mr. James J. Wood for sub-station use. It is constructed so as to be used on either 1,000 or 2,000-volt primaries, of from 60 to 140 periods, and the secondaries are arranged for connection to either a two or three-wire system. This transformer presents a very substantial appearance, while the design and construction is of the simplest, as well as the neatest, possible character. The ventilation is so perfect and the radiating surface so large in proportion to the output that the rise in temperature is very low, even when run for 11 hours on full load. The regulation is within 2¼ per cent, while the efficiency at full load is 98.33, ¾ load 98.39, ½ load 98.33, ¼ load 97.30, ⅛ load 95.09, 1/16 load 90.82. This is claimed to be the highest efficiency ever obtained with an alternating current transformer. At present two sizes are ready for the market, 375 and 750 lights, respectively. The dimensions over all of the 750-light size are: Floor space, 18x39½ inches; height, 28½ inches; weight, 1,860 lbs. The dimensions of the 375-light size are: floor space, 15x32 inches; height, 24¼ inches; weight, 933 lbs.



THE FORT WAYNE NEW 750-LIGHT TRANSFORMER.

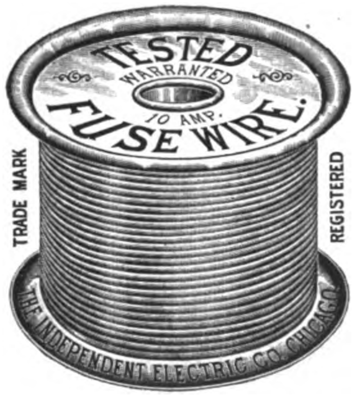
A Convenient Push Button.

The accompanying illustration shows a table push button manufactured by Huebel & Manger, 286 Graham St., Brooklyn, N. Y. Its general design and method of attaching to the table is clearly shown in the cut. It is most convenient as it is easily attached to the table and takes up but a very small amount of room. It is durably constructed and neatly finished.



A CONVENIENT PUSH BUTTON.

A WELL-KNOWN TRADE MARK.



The accompanying trade mark will be immediately recognized by all users of fuse wire. It has been prominently before the public for a number of years and as it appears on all packages of fuse wire manufactured by the Independent Electric Company of Chicago it has become well known to the electric lighting fraternity. It is certainly an effective trade mark, being a representation of a spool of fuse wire. This brand of fuse wire has obtained a favorable place among users on account of its uniformity and also the attractive and convenient manner in which it is packed. The price of fuse wire has recently been reduced, which has had a marked effect on the business in this line. Revised price lists have recently been made.

Societies and Associations.

CHICAGO EXAMINATIONS FOR ADMISSION TO LEHIGH UNIVERSITY.

The Western Society of Engineers will extend the courtesy of one of their rooms to Lehigh University on June 21st, 22d and 23rd, in which to hold its local examinations for admission to the Freshman class. The examinations will be under the direction of Mr. H. F. J. Porter, western representative of the Bethlehem Iron Co.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

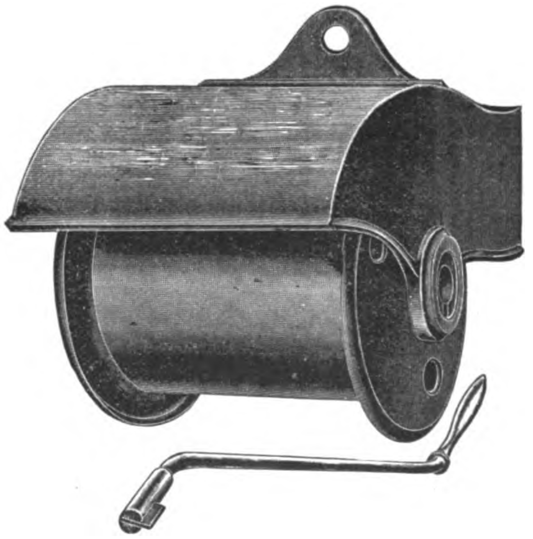
The annual meeting of the American Institute of Electrical Engineers were held at the rooms of the institute on May 21st. The reports of the council, secretary and treasurer showed a total membership of 944 members, receipts during the year of $10,617, which was also the amount of expenditures for the year, and the institute in other ways to be in excellent condition. The election of officers for the coming year resulted as follows: President, Dr. Louis Duncan of Baltimore; Vice-Presidents, Dr. M. I Pupin, New York, W. F. C. Hasson, San Francisco, A. S. Hibbard, Chicago; Managers, Carl Hering, Philadelphia; B. J. Arnold, Chicago; Chas. F. Scott, Pittsburg, and Dr. C. T. Hutchinson, New York; Treasurer, Geo. A. Hamilton, New York City. The date of the general meeting was fixed for June 25th to 28th inclusive at Niagara Falls.

WESTERN SOCIETY OF ENGINEERS.

At the meeting of the Western Society of Engineers held at Science Hall, Armour Institute, on May 14th, Mr. Daniel W. Mead presented a paper on the "DeKalb, Ill., Municipal Electrical Pumping Plant," which was illustrated by lantern slides. The paper outlined a history of the water works at DeKalb, the plants formerly in use, their cost and expense of operating. The revenue during 1893 and 1894 failed by nearly a thousand dollars to meet the operating expenses. The expense for pumping was 10.8 cents per thousand gallons. The experience of the city with artesian wells was described and a description of the geological formation of northern Illinois and southern Wisconsin was given as an aid to the better understanding of the subject. The plant now installed, operated by electric motors, was described in detail. The pumps, motors, registering and recording instruments were described and illustrated. The efficiency of the motors was given as from 84 to 91 per cent according to load; of the pumps from 60 to 78 per cent and the total efficiency of the entire system from engines in the power plant of De Kalb Electric Co. to the water pumped about 47 per cent. The DeKalb Electric Co. has a contract with the city for ten years whereby it operates the plant, furnishing power, oil, waste and labor for any repairs. In the city clerk's office there are recording instruments which keep a record of the amount of water pumped, the height of water in the reservoir, etc. The contract price is four cents per thousand gallons a saving of nearly seven cents per thousand gallons. Mr. Mead's estimate for the new plant operated by steam power with *capable* man in charge was something less than six dollars per day, the plant pumping the estimated amount of water required, 200,000 gallons. The special point made by Mr. Mead, which was referred to several times in the discussion of the paper, was the necessity of greater attention being given to efficiency and economy in the smaller plants. The larger plants receive the most careful attention in this regard while with the smaller plants the matter is not given the attention it deserves.

The Ayer Arc Lamp Windlass.

The accompanying illustration shows the Ayer arc lamp windlass, the agency for which has recently been secured by the Metropolitan Electric Co. of Chicago. It is very simple in construction, substantial and durable. It has a self-locking device and a cover which protects the cable from sleet and ice. The handle is of light construction and is convenient to carry. It is neat in appearance and will be found a most satisfactory device.



THE AYRE ARC LAMP WINDLASS.

The three electric locomotives for the Baltimore tunnel were recently completed at the works of the General Electric Co.

ELECTRICAL CATECHISM

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[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

[COMMENCED IN FEBRUARY, 1895.]

65. *Can any practical use be made of the electricity from belts?*

It might possibly be used for making ozone, ammonia or nitric acid; but, so far as is known, it has not been so used to any great extent. Much can be learned from it, however.

66. *Can any interesting experiments be made with it?*

Yes. Many instructive and interesting experiments may be made with simple apparatus to show attraction and repulsion, conduction, induction, the effect of points, the action of the condenser, the magnetic, heating and physiological effects of electricity.

67. *How can attraction and repulsion be shown by electricity from a belt?*

Hold a doll's head near a belt; the hair will be attracted to it, and each hair will stand on end as if attracted by the belt, and also as if repelled by all the other hairs. A similar effect occurs if one places his own head near the belt, being careful, of course, not to get caught by it. A bunch of narrow strips of thin paper held above the belt shows the same effect. An amusing experiment is suggested by Fig. 10. Small images are cut from dry pith of the elder or cornstalk and are placed on a metallic pan or plate that is connected with the ground. Directly above them is suspended a similar plate that is well insulated from the ground, but is connected with a wire or brush near the belt. If the belt is giving off electricity, the pith images will be attracted by the charged upper plate. As soon as they touch it they become charged with the same kind of electricity as the plate and are repelled and fall to the lower plate, where they lose their charge and are again attracted by the upper plate. In this way they will dance up and down in a very amusing fashion. Instead of the pith images, bits of straw, brass or paper may be used; they make a miniature hailstorm.

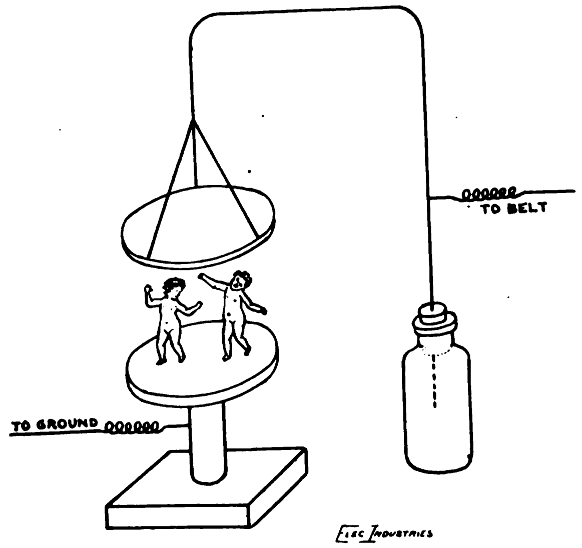


FIG. 10.

68. *Can electric bells be rung by static electricity?*

Not ordinarily. A special kind of bell known as the "electric chime" may be operated by static electricity from a belt or other source. The method is shown in Fig. 11. Two or more bells are suspended at the same height and about three-quarters of an inch apart. The bells are alternately connected with the ground. The remaining bells are well insulated and are connected with a wire or brush that collects electricity from the belt. A light metallic ball is suspended between each pair of bells by means of a silk thread. The ball will be attracted by the bell that is charged from the belt. After touching the bell it becomes charged with the same kind of electricity and is repelled from that one and then is attracted by the grounded bell until it strikes the bell. It immediately loses its charge and swings back and forth, ringing both bells continuously. The electric chime was invented by Benjamin Franklin in 1752, to indicate the presence of thunderclouds.

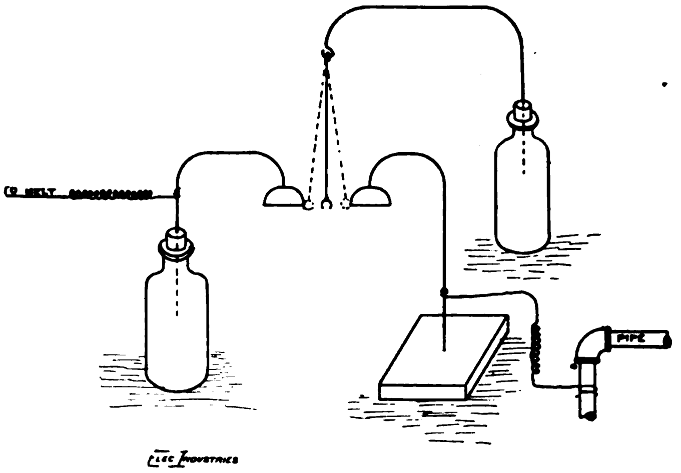


FIG. 11.

69. *What is conduction?*

An example of conduction of static electricity is seen by holding a wire or piece of pipe near a belt. If it is giving off much electricity, one will get a shock through the pipe as strong as from the belt itself. Sometimes one may get a shock from a machine or from a line of shafting or from a belt-shifter. The electricity comes from the belt and is conducted away by the metal. Static electricity may be carried considerable distances if the conductor is well insulated. The static electricity from dynamo belts sometimes gets over to the circuits and is carried along the wires long distances. An example of conduction of static electricity is suggested in Fig. 12, in which two tin pails are connected by a wire and suspended by means of dry cords

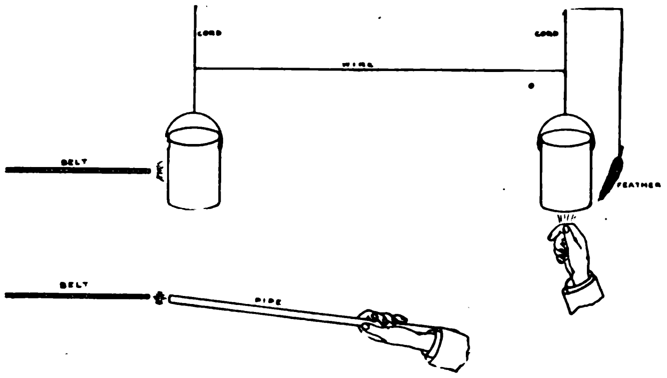


FIG. 12.

or threads. If one pail is near a belt a shock may be obtained by touching the other pail. If the belt is not generating enough electricity to give one a shock it may be detected by means of a small pith ball or bit of feather held near the pail by a silk fiber.

70. *What is meant by the induction of static electricity?*

Hang a tin pail near a belt. Several inches from the first pail hang a second pail that is connected with a third one by a wire, as suggested in Fig. 13. All of the pails should be suspended by dry cotton or silk thread, or should be placed on dry glass jars or bottles, so as to be well insulated from the ground. When the first pail is well charged with electricity from the belt one may get a shock from touching the third one. The pith ball or feather electroscope will also show that the third one is charged. Since the second and third pails are well insulated from the first and from the belt, and since they are too far apart for the electricity to pass through the air to them, the electricity does not seem to get into them by conduction but by some other process. This is explained by the principle of induction. The first pail is given a positive charge by the belt. According to the two-fluid theory the positive charge attracts the negative electricity in the other pails and repels the positive electricity. The negative gets as close as possible to the positively charged first pail, that is, it goes to the second pail. The positive gets as far away as possible and is found to be in the further or third pail, and it leaves that also when the hand or any other conductor allows it to go still further away.

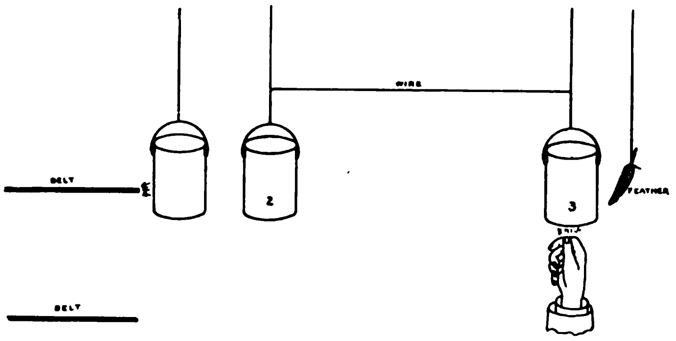


FIG. 13.

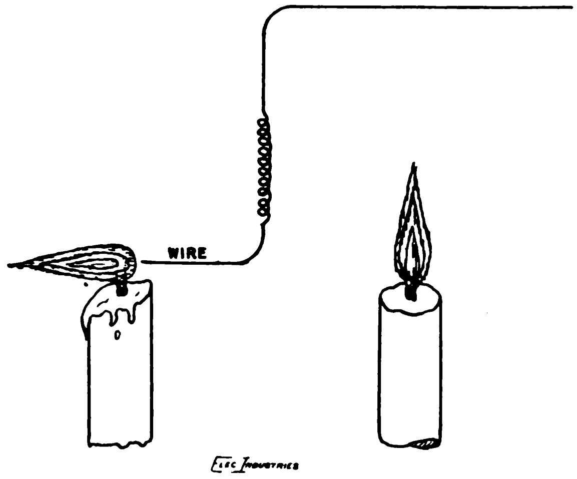


FIG. 14.

71. *What effect do points have upon static electricity?*

They scatter it. An interesting experiment is to connect a pointed wire with a spark collector and bring the point near to a candle, as suggested in Fig. 14. A sort of wind seems to come from the point and blows the flame to one side, or may even extinguish it. A similar thing occurs in the electric whirligig.

72. *What is an electric whirligig?*

It consists of a number of wires radiating from a common center and resting upon a metallic point upon which they may rotate with but little friction. The outer ends of the wires are pointed and are bent backward like the arms of a lawn sprinkler as in Fig. 15. One may be made by soldering several wires of the same length to a small tin disc the center of which has been slightly raised by a center punch so as to form a socket or bearing. Balance this upon the pointed end of a stiff wire or needle that is well insulated from the ground. Connect the upright wire or needle to the spark collector or to a wire near the belt. If the whirligig is nicely balanced and the standard is well insulated, it will rotate as long as the belt is giving off electricity to the wire.

73. *How is this effect of sharp points explained?*

The reason generally given is that static electricity stays on the outside of conductors or in the insulating medium around them. Where the conductor is small, the charge seems to pile up, its density being inversely proportional to the radius of curvature of the surface. At sharp edges or points, the charge is stronger or denser than at other parts of a conductor. Since electricity of the same kind repels itself, it tends to scatter or discharge at such places. When the insulating material (often called the *dielectric*) is air, oil or other fluid, the dielectric itself is repelled and a current is set up, each particle of air or oil carrying away some of the charge. This is nicely illustrated by the candle and the whirligig. The current of electrified air from the point blows the candle flame. The charge upon the point is also repelled as strongly and there is a backward pressure upon the wire exactly equal to that of the current of air. If the point is free it will move backward, as shown by the whirligig, which is something like a turbine water wheel.

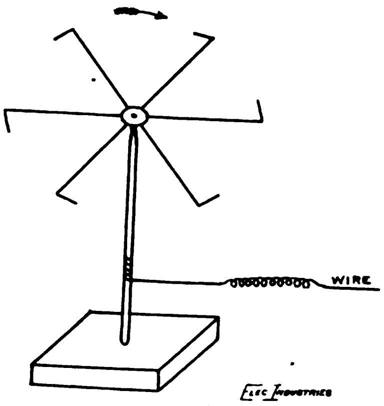


FIG. 15.

The Telephone and its Troubles.

When the telephone was first used on a telegraph circuit, it was noticed that hissing and frying sounds could be heard as well as telegraphic signals of all sorts, all of which had their origin in other electric circuits. Sometimes these extraneous noises were so much stronger than the telephonic speech that they quite overpowered it. The din destroyed the articulation. This was the case when the automatic Wheatstone transmitter was employed on a telegraph circuit parallel to a telephone circuit on the same poles. This was at first interpreted as being due wholly to induction, and for business purposes telephone lines were removed as far as practicable from telegraph lines. The trouble did not cease. In some cases it was nearly as bad as before; and then it was apparent that the source of the disturbance was the earth itself. Both circuits made use of it as a part of their systems, and their ground connections were adjacent, oftentimes practically the same. When the telephone ground, as it was technically called, was moved away, there was some relief, but it was found possible to detect telegraph signals from lines separated by miles of earth.

When compared with telegraphic instruments, the telephone is found to be exceedingly sensitive. A sounder requires about the tenth of an ampere to work it properly, a relay, about the hundreth of an ampere; but a telephone will render speech audible with less than the millionth of an ampere, and is, therefore, more than ten thousand times more sensitive than a telegraphic relay. When the earth is made to form a part of an electric circuit, the current does not go in a narrow strip from one ground terminal to the other, but spreads out in a wide sheet much broader than perhaps most have imagined. Thus, if the grounds be no more than three or four miles apart, the spreading earth current can be traced in a sheet as much as two miles wide. If the grounds be still further apart, the sheet will will be correspondingly wider. This earth current in its course may meet with streams of water, gas and water-pipes, and other conductors better than the earth itself, and these will conduct some of it, but not all. The stronger the current the more it is spread, and a telophone ground connection anywhere in its path will receive its share unavoidably.

In cities and towns employing the trolley railway systems, the rails form part of the circuit. As they lie upon the earth, the earth necessarily conducts away a notable part of the current, no matter how large the rails and good the connection. For instance, in Boston, where great pains has been taken to provide ample metallic conductors in rails and return wires, a thousand amperes have been found to return through the earth to the power-house, and this is something like ten per cent of the whole output. How widely such a current may spread may be imagined, and one may compare such a current with the minute one needed for telephonic work. One must remember that a steady current does not affect the telephone at all. It is only when the current varies in strength above a certain rate, thirty or forty times a second, that it begins to be troublesome. The variations in strength come from the Morse key or its substitutes in telegraphy, from some types of arc lighting dynamos, from alternating dynamos for incandescent lighting, and from the motors in railway work. Though there be thousand amperes in the earth, if the variation be but one ampere, the nine hundred and ninty-nine which are constant are not offensive, hence it does not so much matter how much current is in the earth as how rapidly it varies. There are other currents in the earth due to natural causes, such as lightning, auroras, etc., which have sometimes been destructive to the telephone and its connections. To protect both service and the telephone itself there is one remedy, namely, to cease using the ground as a part of the needful circuit, and to provide each instrument with a complete wire circuit. Telephone companies are adopting this method everywhere as fast as practicable. It is more costly to establish and maintain, but it has been made necessary by the nature of electrical action and by the great increase in industrial enterprises within the past ten years.—A. E. Dolbear in Cosmopolitan.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

A HOT MOTOR.

I like to know something about the apparatus of my car, as it will sometimes enable me to protect my car from serious injury. I have tried on every occasion to get pointers, and expect to get considerable benefit from Electrical Industries, for which I have recently become a subscriber. I think a motorman should inspect his motors at the end of the line on every trip. I discovered several times hot bearings, hot motors, loose connections, etc., that would have ruined things if left to themselves. Not very long ago I pulled out a car that had been in the shop for a week. I had made a half trip light, and stopped to look the car over before I returned, when I discovered one motor so hot I could scarcely touch it. I knew something was wrong, so I cut out that motor and ran back with the other one and to the barn. I never knew what was the matter with it, but it stayed another week in the shop. I also have discovered, just as we got a few warm days, that the boxes would be hot, the grease all out. A little grease has saved the axle, or oil if I didn't have grease. It takes but a minute to raise the trap door and look at things, and I think that the men whose cars are always out of repair don't stand as good a show when it comes to cutting down the force. I would like to know what makes the motors get hot and what is the opinion and custom in other cities on the motorman inspecting his car. Horace H.

SUBMARINE CABLES.

Editor Electrical Industries: Dear Sir.—Will you kindly explain why a submarine cable carrying an alternating current of 1000 volts should cause the fuses to blow when the cable is in good condition and stands a satisfactory insulation test? How is this difficulty overcome in practice, and does the insulation of a cable in service on alternating systems deteriorate sooner than one used for continuous currents? If you cannot devote the space to answering these questions please refer me to some comprehensive work on the subject. Respectfully, F. J. F.

Elgin, Ill.

OVERLOADED ARC MACHINE.

In carrying a full or over-load on arc machines they carry a bad spark at the brushes. What can I do to cut down that spark? Subscriber.

TECHNICAL SCHOOLS.

Dear Sir:—Will you kindly give me through the columns of your paper, Electrical Industries, a little information as to schools where the mathematical and scientific branches of electricity are taught. I have been employed in a power-house at practical work for three years; am now twenty, and am planning for one year's study at some institution. Please state, if possible, the cost of tuition, fees, etc. F. M. E.

Milwaukee, June 4, 1895.

New Works of The Westinghouse Machine Company.

Contracts have been let and ground broken for The Westinghouse Machine Company's new shops at East Pittsburg. A few years ago the Westinghouse Air Brake Company erected large shops at a point on the main line of the Pennsylvania Railroad, about twelve miles from Union Station, Pittsburg, where the town of Wilmerding was laid out and built. The location at East Pittsburg of the Westinghouse Electric & Manufacturing Company's immense plant, and the Fuel Gas & Manufacturing Company's factory, to be followed now by the removal of The Westinghouse Machine Company to the same place, will form, with the Union Switch & Signal Company's works at Swissvale, a concentration of Westinghouse interests, practically at one point, within a half-hour's ride of the city.

The main building of The Westinghouse Machine Company's new shops will be 602 ft. by 230 ft. The construction throughout will be as nearly fire-proof as modern building methods can devise. To meet this proposition, the specifications call for a steel structure with brick walls, slate roofs, wire glass skylights, etc., etc. A building of similar construction, 200 ft. by 60 ft., will contain the hammer shop and power plant.

Within the main building, through which switches are run direct from the main line of the Pennsylvania Railroad, will be the machine shop, erecting shop, foundry, pattern shop, warehouse, office, etc. Two crane runways, each 60 ft., span, on which electric cranes of the latest improved design will be used, extend the length of the building. The remaining space is taken up with galleries, provided with lighter crane service. The present equipment of machine tools will be increased by the addition of whatever is best, to facilitate the manufacture and handling of the company's enormous product.

The hammer shop will have every convenience that the best shop practice can suggest, for doing work thoroughly and expeditiously. It will be equipped with one 8-ton, one 3-ton, one 2-ton and several smaller hammers, besides the usual cranes, etc.

It is estimated that the cost of the buildings alone, will reach $400,000. The contracts call for completion November 1, 1895. The following are the names of the contractors: Stone work, Fred. Gwinner; brick work, Steele & Hall; carpenter work, George Hogg; structural steel, Keystone Bridge Works; galvanized iron and skylights, T. W. Irwin; slating, Aiken & Company.

FINANCIAL.

Greater activity in all departments of trade have been noticeable the past month and the situation is nearer that of previous years. An advance in prices may be expected. The greater demand for goods of all kinds has caused an advance in many lines and higher prices in wire, electrical supplies and apparatus is predicted. The narrow margin with which business has been done for months past has given little profit either to manufacturers or dealers. The markets have shown more life, even during the summer heat, which generally has the reverse effect. American securities are in greater demand abroad and prices are firm. Electrical stocks are stronger in general. The advance in American Bell Telephone is especially noticeably due in a measure to the decision in the Berliner patent case. The business of the company is said to fully warrant the advance.

Several companies have increased their resources and are preparing to enter the field more actively. Among these companies is the Standard Electric Co., Chicago, which recently certified to an increase of capital stock from $1,000,000 to $1,500,000. Mr. A. G. Spaulding, the well-known lover of field sports and head of the firm of A. G. Spaulding & Bros., was elected president. Mr. E. E. Crepins remains treasurer and Mr. D. P. Perry the general manager. Among the directors of the company are Mr. Gilbert B. Shaw, president of Am. Trust & Savings Bank of Chicago, Mr. J. B. Whitney, a capitalist of Philadelphia and Mr. G. A. Rollins of Boston.

TRADE PUBLICATIONS.

"Self-Culture," a monthly devoted to the interests of the Home University League and published by the Werner Company, Chicago, contains in the May number an article headed "Is Vitality Electrical?"—an article of several pages in which the opinions of several philosophers are compared.

A new monthly publication, entitled "Engine and Boiler Room," has made its appearance, the first number of Vol. I. being just at hand. It is published at Chicago. One of the best features of the new publication is the color of its cover, which is that by which ELECTRICAL INDUSTRIES is everywhere recognized. Get something original, neighbor!

A catalogue of switches has recently been issued by the General Incandescent Arc Light Company, of New York, which shows an extensive line of central station switches of various sizes and for different systems. The switches are extensively illustrated and are listed for the various sizes manufactured. This catalogue may be obtained either from the main office of New York or from the western agent, L. E. Frorup, 169 Adams St., Chicago.

Some interesting facts about incandescent lamps in general, of the Packard in particular, are presented in a very tasty little pamphlet recently issued by the New York & Ohio Company of Warren, O. It contains some interesting information regarding the efficiency and maintenance of candle power of the Packard lamp which are shown by curves giving the candle power up to 800 hours. Other interesting facts are presented along with these curves regarding the value of lamps in general.

The new general catalogue of the Osburn Electric Supply Co. presents in a condensed form, most convenient for reference, a very extensive line of general electrical supplies. The catalogue is nicely arranged and the matter is well indexed. The list of supplies includes almost everything used in electrical work either for interior or exterior wiring, for central station or isolated plant. It makes a volume of about 300 pages, 5½ by 7½ inches.

A very artistic little pamphlet showing recent designs in electric fans and chandeliers has recently been issued by Molyneux Electric Manufacturing Co., of 17 Ellicott St., Buffalo, N. Y. In design and make up the pamphlet exhibits the latest ideas in the printer's art. Its contents present effectively this new device which combines not only the lighting features, but also that of an electric fan, which enables it to be used for either or both purposes.

A very neat pamphlet, entitled "A Treatise on Gas Engines and Electrical Power Up to Date," has just been issued by the American Gas Engine Electric Co., Dexter Bldg., Chicago, representing the double-acting gas engine manufactured by the American Gas Engine Co. and Messrs. Dick, Kerr & Co., London, Eng. The invention of the double-acting gas engine and the procurement of the Griffin patents by the above companies are related. The advantages of this principle and the improvements made in the gas engine are described. The economy of the gas engine for electric lighting is pointed out. These pamphlets may be had on application.

A pamphlet containing a list of purchasers of the Ball engines manufactured by the Ball Engine Company, Erie, Pa., for operating electric lighting dynamos has recently been issued. It shows an extensive use of the Ball engine in nearly every state in the union. They are not confined to any one section but are distributed through the north, east, south and west. The individuals and companies in the list are the most prominent in the various sections. The list is certainly a large one and shows the wonderful success of the company. These lists are furnished upon application and also their list of street railway purchasers.

The Manhattan Electrical Supply Co., 32 Cortlandt St., New York, has recently sent out Catalogue No. 7 of electrical supplies. It contains extensive illustrated lists of telephones and telephone systems, batteries and material, alarm and annunciator systems of various kinds, electric bells, electric fans, lamps, telegraph supplies, tools, etc. It contains more than 200 well-arranged pages and presents to good advantage some of the well-known electrical goods of this house.

The subject of incandescent lamps is well presented in a recent catalogue issued by the Columbia Incandescent Lamp Co. A very neatly designed embossed cover gives it an attractive appearance. The use of brightly colored inks on enameled paper also makes the interior bright and attractive. The illustrations of lamps are printed in two colors and the accompanying text in a third color. A great variety of lamps are shown for general and decorative lighting. Mr. Rhotehamel reports that he has a large supply of these catalogues and is pleased to send them to anyone who has not already received a copy.

The Solar Arc Lamp Co., 280 Broadway, New York, has recently issued a folder which displays a great variety of arc lamps on constant potential circuits from 90 to 125 volts. The lamps are run two in series on such circuits. The styles shown exhibit various degrees of ornamentation from the plainest out-door lamp to the highly ornamented lamp for interior lighting. The folder also shows the interior of the lamp, displaying the simple construction of the regulating mechanism and of the positive action of the feed. There are no springs or dash pots in the mechanism. The folder also has the address of the western selling agents for these lamps, the Metropolitan Electric Co., 186 and 188 Fifth Ave., Chicago.

"Electrical and Brass Goods," by Huebel & Manger, 286-290 Graham St., Brooklyn, N. Y., has recently been issued. It contains descriptions and lists of the well known lines of goods handled by the above firm. Many new designs are given in bells, push-buttons and brass fittings. Some of the special features in the construction of the bells are pointed out, among which are the use of pure platinum for the contacts, an improved lock nut and the immovable binding posts. The electric bells constructed with these improvements are always reliable, the weak points of the old style bell being made the strongest in these. The catalogue is well gotten up and the numerous cuts show a great variety of styles.

A handsome catalogue has recently been issued by the Commercial Electric Company of Indianapolis, Ind. The matter is printed on heavy enameled paper and is bound by silk cord. The cuts illustrating the different types of dynamos manufactured by this company have been prepared with great care and show clearly the details of the machines. The dynamos are built both for belting and direct connection. Power and railway generators are shown as well as lighting dynamos. The special features of the machines are described in the text. The catalogue also shows the standard type of switch board installed by this company with their machines. It is very neatly designed; marble face enclosed by neat frame and having besides instruments, switches, etc., ornamental electric lighting brackets, which add much to the appearance of the board.

Catalogue No. 27 of the "Central Valve" engine has just been issued by the M. C. Bullock Mfg. Co., Chicago. The engine is illustrated and described. Engravings show numerous plants, both in Europe and America, which are using the Willans engine. The engine is also shown in a number of combinations with dynamos of different kinds. The direct coupled arc dynamo is an innovation which the Willans engine has brought about. The reader is undoubtedly familiar with the plant of the Mutual El. Lt. & Pr. Co., which was described in ELECTRICAL INDUSTRIES for February. The central valve engines in this plant driving 125 light arc dynamos direct are an advancement in the generation of electricity for arc lighting. An item of especial interest is a letter from Mr. Alexander Siemens, with curve showing the combined efficiency of Willans engines and Siemens Bros. dynamos in a plant at Glascow, The tests were made under the supervision of Prof. Kennedy, the well-known engineer. The efficiency shown is believed to be the highest yet attained for a combination of engine and dynamo.

NEW BOOKS.

A Text Book on Electro-Magnetism and the Construction of Dynamos. Vol. I. By Dugald C. Jackson, New York. Maxmillan & Co. 300 pages price: $2.25.

This book has been prepared by the author to meet a demand for a text book that would serve as a satisfactory basis of instruction in colleges. The contents therefore exhibit a gradual advancement from the primary definitions and principles to the more complex problems of dynamo construction. Alternating current and series arc lighting machines are not reached in this volume but the construction of incaneescent lighting dynamos is well covered. The first parts of the book treat of simple magnets, the magnetic properties of iron, the establishment of electric pressures, etc., which are considered at length, preparing the student for a better understanding of dynamo construction. The magnetic circuit of the dynamo is treated, then its regulation, efficiency, etc., and the application of the principles to the construction of dynamos.

"Electricity in Medicine from a Modern Standpoint" By Wm. Jas. Morton, M.D., New York, 1895. D. Appleton & Co. Paper.

A contribution on the discussion before the Medical Society of the State of New York, reprinted from the New York Medical Journal. The importance of this subject, which is so little understood by the average practitioner, discussed by this well-known authority cannot fail to be of interest to a large class of readers The convenient form in which it is published enables it to be not only read but filed for future reference. After a short introduction the author touches upon the relation of the physician and the electrical engineer in which he urges the study of the use of electricity in medicine. He then enters upon the discussion of electricity and magnetism in the treatment of disease.

Electrical Engineering for Electric Light Artisans and Students, by W. Slingo and A. Booker. New and revised edition 1895. London and New York. Longmans, Green & Co. 750 pages, 346 illustrations; price $3.50.

A thoroughly practical work for electric light employes and students. The first edition of this work which appeared in 1890 supplied a want that nearly every student had experienced, for a complete work covering the field of electric lighting. This advancement in the art of electric lighting and new methods introduced made this recent edition necessary. An entire revision has been made and the work brought down to date. The subject is treated in a plain, clear style and illustrated by numerous cuts and drawings. Each branch of the subject is gradually worked up from the elementary principles in such a manner that the reader is gradually drawn into the more complex studies, learning the underlying principles as he progresses. Mathematical formulae are omitted as far as possible so that the contents are understood by the average reader. The electric current, the electrical units and electrical measurements are considered in the first part of the work; the generation of currents and dynamo-electric machinery follows, and electric motors and various auxiliary lighting devices and methods of installation are next treated. The subject is well covered and electrical workmen or anyone seeking a practical knowledge of electric lighting will find this an excellent help.

PERSONAL.

Mr. L. A. Scovil was recently appointed superintendent of the City Railway Co. of Dayton.

H. C. Adams is now in charge of the New York offices of the Ft. Wayne Electric Corporation.

Mr. Benjamin Morton has resigned the presidency of the Atlantic Ave. Railroad Co. of Brooklyn, N. Y., to take effect July 1st.

W. F. Parish, Chicago, representing Racine Hardware Co., has removed his offices to the fifteenth floor of the Marquette Building.

Mr. R. L. Weithas, formerly with the Electrical World, has accepted the position of secretary and manager of Burrelles Press Clipping Bureau.

Mr. Jas. C Hobart, of the Triumph Electric Company, Cincinnati, was in Chicago a short time last month. He reports business booming in his line.

Prof. Crocker recently concluded his course of lectures at Columbia College on "How Electricity is now being Utilized," which were greatly appreciated by the large number attending.

Mr. W. K. L. Dickson, for a long time connected with the Edison laboratories, has accepted the position of electrical engineer of the Portable Electric Light & Power Co., Watts St., New York.

Dr. Fred. Bedell, of the physical department, Cornell University; the engagement is announced of Dr. Bebell to Miss Mary Crehore of Cleveland, O.

Mr. J. C. Shainwald, western manager of the Standard Paint Co., with offices at Chicago, was married recently to Miss Julia H. Barnard of San Francisco. Upon their return from a wedding trip Mr. and Mrs. Shainwald will make their home at the Yorkshire on Michigan Ave.

Mr. W. P. Preble, son of Mr. W. H. Preble, the secretary and treasurer of the Chicago Rawhide Manufacturing Co., was married Tuesday, June 4th, to Miss Lizzie E. Bannen. After the wedding ceremony the couple left for a trip in the east, upon their return from which they will make Chicago their home. Electrical Industries extends congratulations, and wishes the happy couple every happiness.

BUSINESS NOTES.

The Chicago Insulated Wire Company, Chicago, the well-known manufacturers of insulated wires of all kinds, has removed its office to 153 Lake street. At the new location the company has greatly increased facilities for carrying on its business, having a store on the ground floor and also a large basement for carrying a complete stock.

Chas. A. Schieren & Co., New York, report their factory as very busy on orders which show an increased demand for the better grade of goods manufactured by this company. Their leather belting, tanned by slow process with pure bark, exclusively for belting purposes, always gives satisfaction. The increased number of orders also indicates the return of prosperity.

The Perkins Electric Switch Manufacturing Co., Hartford, Conn., has adopted a new method of packing its incandescent lamps. It conforms more to modern ideas and methods than the manner in which lamps have generally been packed. The method is very much like that used in the packing of eggs for shipment. The lamps are placed in wooden apartments without any wrappings and in wooden cases instead of barrels. When unpacking there are no wrappings to be taken off and she method has proven very satisfactory.

The Forest City Electric Works, Cleveland, O., has recently opened an office in New York, which is in charge of Mr. John C. Dolph, who was formerly connected with the Short Electric Railway Company. The "roll drop" commutator segments of this company are well known to the trade and a large stock both for street railway generators and motors and lighting dynamos will be carried in New York. The eastern trade can therefore be assured of prompt attention.

The Brush Electric Company Cleveland, O., it is reported has recently purchased the property of the Swan Lamp Manufacturing Company and will manufacture incandescent lamps. The name Swan is well known wherever incandescent lamps are used, the name being that of the celebrated electrician, Joseph Swan. This company was organized in 1885 and has never owned its factory building, which was rented from the Brush Company. The plant will be under the direct supervision of the officers of the Brush Company.

The Standard Paint Co., whose P. & B. paint is so extensively used in the United States, being considered one of the of the best insulating materials, is giving more attention to its foreign trade in insulating materials. The agents in London and Paris are forwarding larger orders than ever before and have made arrangements whereby these goods are now being introduced in China and Japan. Many insulating paints have been put on the market but the well-known qualities of the P. & B. are sufficient to continue it as a favorite among electrical wiremen.

H. M. Shaw of 126 Liberty St., New York, is manufacturing a Lightning Arrester for Electric Lighting & Railway protection, which is creating considerable attention among electrical engineers. It combines the known successful principles of diverting the lightning discharge from entering the generating station car motors and line transformers It is designed by a well-known electrical engineer, who has made this line of electrical machinery his specialty. Mr. Shaw is also New York manager for the Eureka Tempered Copper Co., who manufacture commutators, segments and brushes.

The Metropolitan Electric Co , 186 and 188 Fifth ave., Chicago, reports a good demand for the Dayton electric ceiling fan, for which they are Chicago agents. The company recently furnished the lamps for the large illuminated tower of A. M. Rothschild & Co., which has attracted so much attention since the lights were turned on. Among recent orders of wire and cable shipped was one for 25000 feet of 000. The many street railway specialties and supplies are in good demand. Among recent agencies secured is the exclusive agency for the United States of the Ayer self-locking windlass, which contains many improvements.

Jas. G. Biddle, 525 Drexel building, Philadelphia, who for some five years was manager of the electrical department of Queen & Co., has recently opened an office at the above address as a dealer and manufacturers' agent for scientific and electrical apparatus. He represents Elliott Bros. of London, who are widely known as manufacturers of electrical measuring and scientific instruments. Their instruments have been awarded prizes at a number of World's expositions and are generally recognized as superior goods. Mr. Biddle has also arranged with the Weston Electrical Instrument Co., of Newark, to handle their instruments as special agent. Besides handling this line of goods he is selling agent for the Electric Storage Battery Co.

Edward F. Austin, manager of the Pittsburg office of the Phœnix Iron Works Co., of Meadville, Pa., manufacturers of the improved "Dick & Church" automatic cut-off engines, reports the following recent sales, one 16 x 15 "Dick & Church" automatic cut-off engine to the National Water Works & Construction Co., two 300-H. P. "Dick & Church" engines to the Mt. Clemens Electric R. R., three 14½ x 15 automatic cut-off engines to the National Tube Works Co., of McKeesport, and one 18½ x 18 "Dick & Church" automatic engine, together with two boilers, feed water heater, pump, etc., to Robert Simons, president of the Pittsburg, Frontenac & Suburban R. R., of Pittsburg, Kas. Mr. Austin reports the boiler department running to full capacity and the outlook for business good.

The Goulds Mfg. Co., Seneca Falls, N. Y., reports the following sales: The Solvay Process Co., Syracuse, N. Y.. One 12 by 12-inch triplex power pump, with steel ball valves, which is to be used for pumping waste; New Orleans Railway & Mill Supply Co., New Orleans, La., two 5 by 8-inch triplex power pumps; both these pumps are to be operated by electric motor, one pump being geared to each end of the armature shaft, the pumps and motor being mounted on one bed-plate; Freydenburgh Falls Pulp Co., Plattsburgh. N. Y., one 10 by 12-inch triplex power pump; Michigan Alkali Co., Wyandotte, Mich., three 6¼ by 8-inch triplex power pumps; Manion & Co., New Orleans, La., two 5 by 6-inch triplex power pumps, and Robinson & Cary, St. Paul, Minn., one 4 by 4-inch triplex power pump. The works are very busy.

The Adams-Bagnall Electric Co., Cleveland, has recently been organized for the manufacture of electrical apparatus. It numbers among its list of officers and employes many who are well-known to the electrical fraternity as inventors and designers of electrical apparatus. Mr. Thos. E. Adams is well-known as inventor of the Brush-Adams lamp. Mr. E. J. Bagnall was also for a number of years connected with the Brush Electric Co., but has more recently conducted an office in St. Louis as consulting engineer, making a specialty of electric railways. Mr. Geo. Arnold has also recently held various positions of responsibility with the Brush company, more recently at the head of the drafting department. Mr. S. T. Dodd, formerly an instructor at Princeton College, has recently been connected with the Brush company in the capacity of dynamic engineer. Possessing not only natural ability but a thorough scientific training in this line, Mr. Dodd is a most valuable acquisition to the staff of the Adams-Bagnall Company. The business manager of the company is Mr. L. H. Rogers, well-known to the fraternity.

The American Wheelock Engine Company has recently been formed by the consolidation of several important engine interests. The patents and rights of manufacture which are acquired by this new company include a number of recent patents on the Greene engine by its inventor, the patents of Edw. K. Hill covering improvements on the Wheelock valve gear as well as the features of the Hill valve gear, the patents of Jerome Wheelock and the rights of Geo. I. Rockwood to the Rockwood system of compounding together with other patents already issued or pending. The engine now being manufactured is the Greene Wheelock. The relations sustained by the new company to the Cramp Company are not made public but it is evident that it is interested, as all the large engine work will be built at Philadelphia and only smaller parts at the Worcester works; and it is also surmised that the Providence Steam Engine Company is in some way interested as some of the features of the Greene valve gear are used in this engine. Hoadley Bros., the well-known engineers, are extensively interested and Mr. Hoadley has already made important contracts at Portland and Boston with electric lighting companies. The engines contracted for aggregate 1600 hore-power.

The Mutual Finance & Construction Co., 40 Wall St., has recently been organized for the purpose of exploiting and building electric light, railway and power plants, making expert examinations, plans, estimates, etc., of such plants. The president of the company is Mr. J. H. Carnes, a retired merchant and capitalist, and Mr. Geo. F. Woolston, general manager. Mr. Woolston is well known in electrical fields, having had several years' experience in this line of work as well as in the building of steam railways. The capital stock of the new company is $100,000, with sufficient paid in to meet all requirements. The company has just contracted with the Quayaquille General Electric Co., of Equador, and will ship at once a complete electric lighting plant, using the Standard Electric Co.'s apparatus, for which it has the general eastern agency. Among other contracts is a large arc and incandescent plant for Hudson county, New York, for lighting the boulevards and county buildings. Plants are also being installed at Kearney, Arlington and Belleville, New Jersey, for both arc and incandescent lights An incandescent lighting plant has just been furnished also for lighting the town of Chatham, N. Y., and the company reports a large number of large contracts nearly closed. It goes without saying the new organization will push sales in its territory.

The Walker Manufacturing Co., Cleveland, O., has taken the following contracts for electrical machinery between the 1st and 15th of May. It will be noted that in three different cases these have been the second or third contracts for the same roads, which shows how their machinery is meeting with favor with the street railway fraternity: The Detroit Railway, Detroit, Mich., one 750 K. W. direct coupled multipolar generator, the second machine; Aurora Street Railway Co., Aurora, Ill., nine complete car equipments, eighteen 25 horse-power steel motors, second order from this road; Akron Street Railroad Co., Akron, O., two 200 K. W. direct coupled generators, three complete car equipments, six 30 horse-power steel motors—this is the second order for generators and third order for motors from this road; New York, Elmsford & White Plains R. R. Co., White Plains, N. Y., one 75 K. W. belted generator, three complete car equipments, six 25 horse-power steel motors; Lakeside Railway Co., Mahonoy City, Pa., two complete car equipmenss, four 50 horse-power steel motors; W. C. Thayer, Cleveland, O., two 200 K. W. direct coupled multipolar generators, ten complete car equipments, twenty 50 horse-power steel motors, one complete car equipment, two 100 horse-power steel motors, and Ashland & Catlettsburg Street Railway Co., Ashland, Ky., two complete car equipments, two 30 horse-power steel motors.

The Ball Engine Co.—The works of the Ball Engine Co., Erie, Pa., present a scene of activity to a visitor, the erecting floors being crowded with engines in process of construction. Especially noticeable by their appearance among the many engines, are three 175 horse-power engines, arranged for direct connection to Mather dynamos, and which are to go to the new Library of Congress, Washington, D. C., in a few days. These engines are painted a dazzling white according to the instructions of the Government, and with their polished brass fittings, certainly present a handsome and massive appearance. Among recent shipments are the following: Rock Creek Railway Co., Washington. D. C., and Chevy Chase, Md., one 300 horse-power tandem compound engine with extended sub base and divided connecting head; Hahne & Co., Newark, N. J., one 125 horse-power; Baltimore City Jail, Baltimore, Md., one 35 horse-power; C. Jevne & Co., store building, Chicago, one 60 horse-power engine direct connected to Siemens-Halske dynamo; City of Wells, Minn., one 70 horse-power engine direct connected to General Electric Co. dynamo; Catholic University, Washington, D. C., two 50 horse-power engines; Tootle, Wheeler & Motter, Store Building, St. Joseph, Mo., one 100 horse-power engine; Mount Washington Light & Power Co., Hollins, Md., one 100 horse-power engine; J. M. Warner, Electric Light Plant, Oneida, N. Y., one 60 horse-power engine; Tarentum Passenger Railway Co., Tarentum, Pa., one 100 horse-power engine; Swofford Dry Goods Co., Kansas City, Mo., one 60 horse-power engine; Juvenile Female Offenders' Home, Geneva, Ill , one 60 horse-power engine direct connected to C. & C. Electric Co. dynamo; C. E. Johnson & Co., Chicago, one 40 horse-power engine direct connected to Western Electric Co. dynamo; J. F. Weissner & Sons, Baltimore, Md., one 50 horse-power engine; Duquesne Electric Supply & Construction Co., Pittsburg, Pa., one 35 horse-power engine; C. D. Kaier Brewing Co., Mahanoy City, Pa., one 60 horse-power engine; Chesapeake Light & Power Co., Hampton, Va., one 40 horse-power engine.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED Position as Electrician and Superintendent of an electric light company, or Superintendent of some construction company. 12 years' experience in general electric construction and management of electric plants having had charge of some of the most important installations in the country. Can furnish the best of testimonials as to ability and attention to duty. Address 756, care Electrical Industries, Chicago.

WANTED: Position as manager or superintendent of central station. Experienced and in every way qualified. Address, Geo. W. Kendrick, Front Royal, Va.

AGENT WANTED for the U. S. A. for the sale of first-class German electric carbons, on commission; apply to FERDINAND HOTZ, 1318 Masonic Temple, Chicago, stating references.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

The American Extravaganza Co. has returned to Chicago after a tour which extended from Chicago to San Francisco, Boston and New York, and presents as an opening piece for the season at the Chicago Opera House "Aladdin, Jr." This popular piece, which has been received so favorably in the many cities in which it has been presented, contains many novelties recently prepared by its able management. The use of the latest electrical appliances for stage lighting produces some marvelous scene effects and lends an attraction to the play which is appreciated by all.

THE LOUIS K. COMSTOCK COMPANY,

Electrical Engineers and Contractors.

Main Office, 1437-38 Monadnock Block, CHICAGO. Branch Office, Hodges Building, DETROIT, MICH.

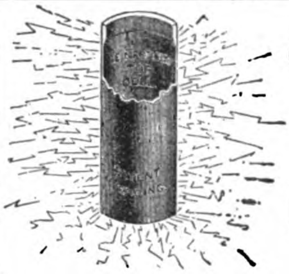
Kneeland Reflector Co. S. R. Kneeland, Original Patentee.

Manufacturers of

Reflector Shades

FOR INCANDESCENT ELECTRIC LIGHTS.

24 Travers St., Write for price list. BOSTON, MASS.



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"HELIOS" CORED CARBONS,

HERETOFORE MANUFACTURED ONLY IN GERMANY, ARE NOW

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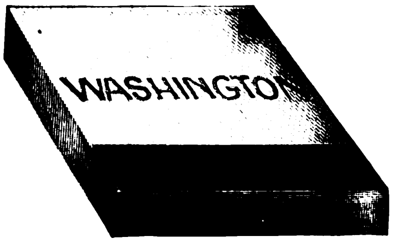
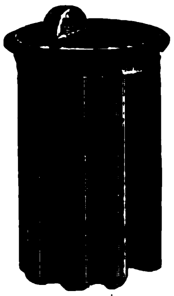
No Longer Necessary to import Them. We can save you money.





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COMPLETE, $2.00 EACH. IN WALNUT AND OAK CASES.

BLAKE TRANSMITTER CASTINGS, $1.00.

PHILADELPHIA TELEPHONE CO. BOX 707 PHILADELPHIA.

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over any fan on the market.

COMPACT, LIGHT AND EFFICIENT.

AGENTS WANTED.

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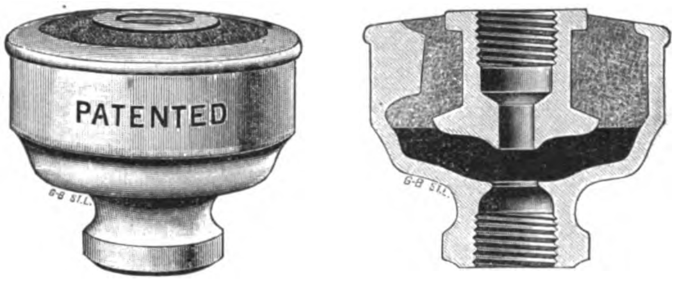
INTERSTATE INSULATING JOINT.



The strongest insulating joint made. Will not twist or break. Insulation resistance infinite.

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813 S. Seventh St., ST. LOUIS, MO.

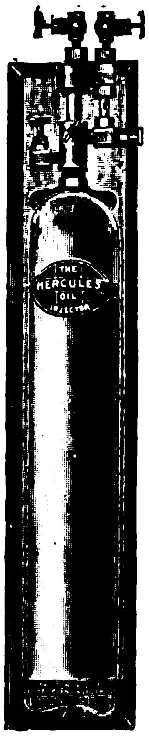
P&B

The splendid reputation made by the **P. & B. Insulating Compounds** during the past ten years has led to any number of feeble imitations Many such have "dropped by the wayside," and the P. & B. graveyard still yawns for others. They advertise their compounds as having "no offensive odor," but electricians know that the offensive odor of **P. & B.** means **Penetration, Adhering and Lasting Quality.**

The Standard Paint Co.

2 Liberty Street,
NEW YORK.

Chicago Agency
Metropolitan Electric Co.
186-188 FIFTH AVENUE.



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New Hercules
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7 Sizes, 50 to 5000 H.P.

Over 1100 in use, keeping over 6600 boilers free from scale.

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less than one cent a day to keep a 100 Horse Power Boiler clean. One pint of kerosene to 5000 gallons of water fed in by the Hercules, will save coal, save cylinder oil, save repairs, save steam. Sent on 60 days' trial to be returned if not satisfactory.

Send for prices, testimonials, partial list of users and discounts.

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The original projectors of this manner of Boiler Cleaning.

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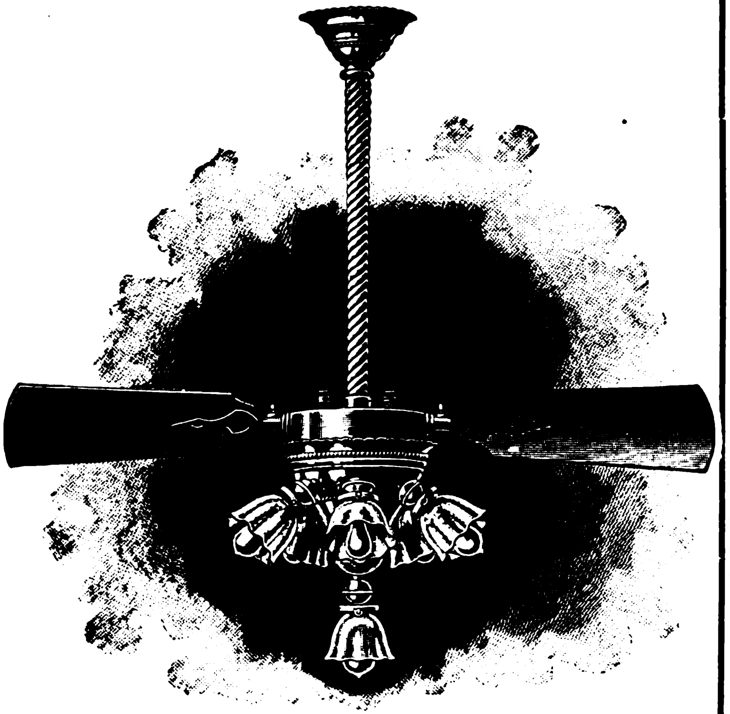

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LORD'S BOILER COMPOUND has a world-wide reputation.

It is indorsed by all the leading authorities everywhere.

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It is exported to all foreign countries where steam is used.

It is the only American production in this line used by Foreign Governments and Navies.

It is the only article mentioned in our scientific and standard treatises on Steam-Engineering, and is very highly recommended in more than thirty of these different works.

This should, without question, be proof of superior merits, and to prove this statement I will send one of these valuable treatises costing from $1.00 to $5.00 per copy, by mail, to any one sufficiently interested in the safety and economy in the use of steam, as to help me secure trade; in this way a very valuable library on Steam Engineering may be procured by the Manufacturer, Superintendent or Engineer.

ADDRESS

GEO. W. LORD,
NO. 306 UNION STREET, PHILADELPHIA, PA.

It will pay Engineers and Steam Users to write me.
In doing so mention "Electrical Industries."

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WIRES AND CABLES

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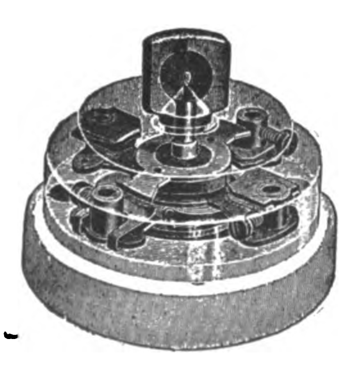

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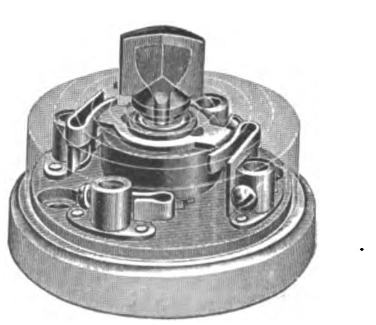

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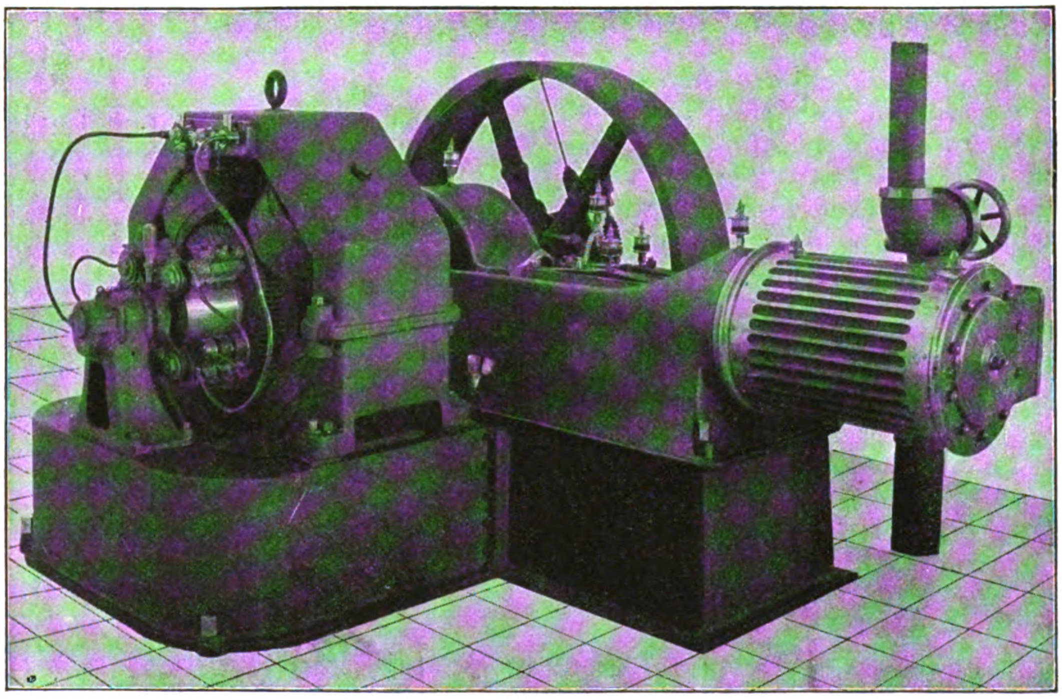

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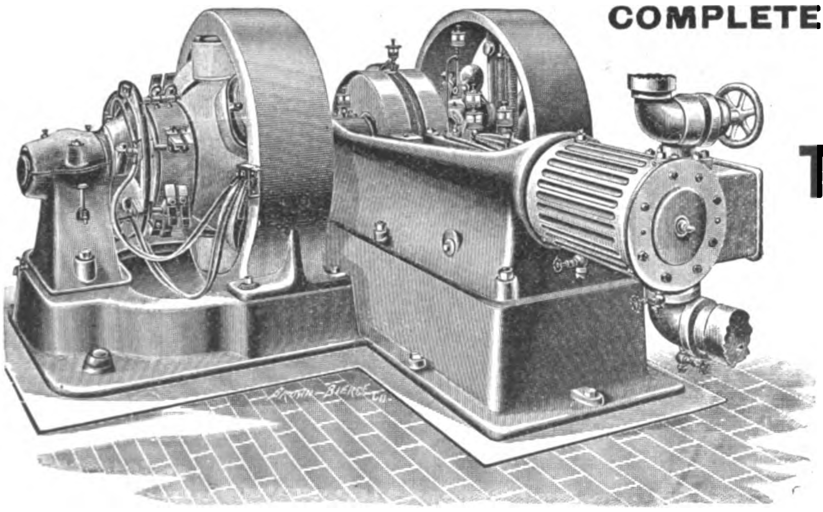

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ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. July, 1895. NEW YORK. No. 7.

The Central Station of the People's Electric Light and Motor Power Co.

For furnishing electric lights to that section of the city of Chicago lying between 88th St. on the south, the lake on the east, Western Ave on the west and 31st St. on the north, the People's Electric Light and Motor Power Co., erected a large station at 55th and Wallace street, Chicago. The original plant at this point has recently been greatly enlarged to handle the rapidly growing business of the company. The plat of ground purchased previous to the erection of the plant will give sufficient space for another building equal in size to the present station when such an addition is required. The equipment of this central station possesses a number of important features in both the equipment and its arrangement.

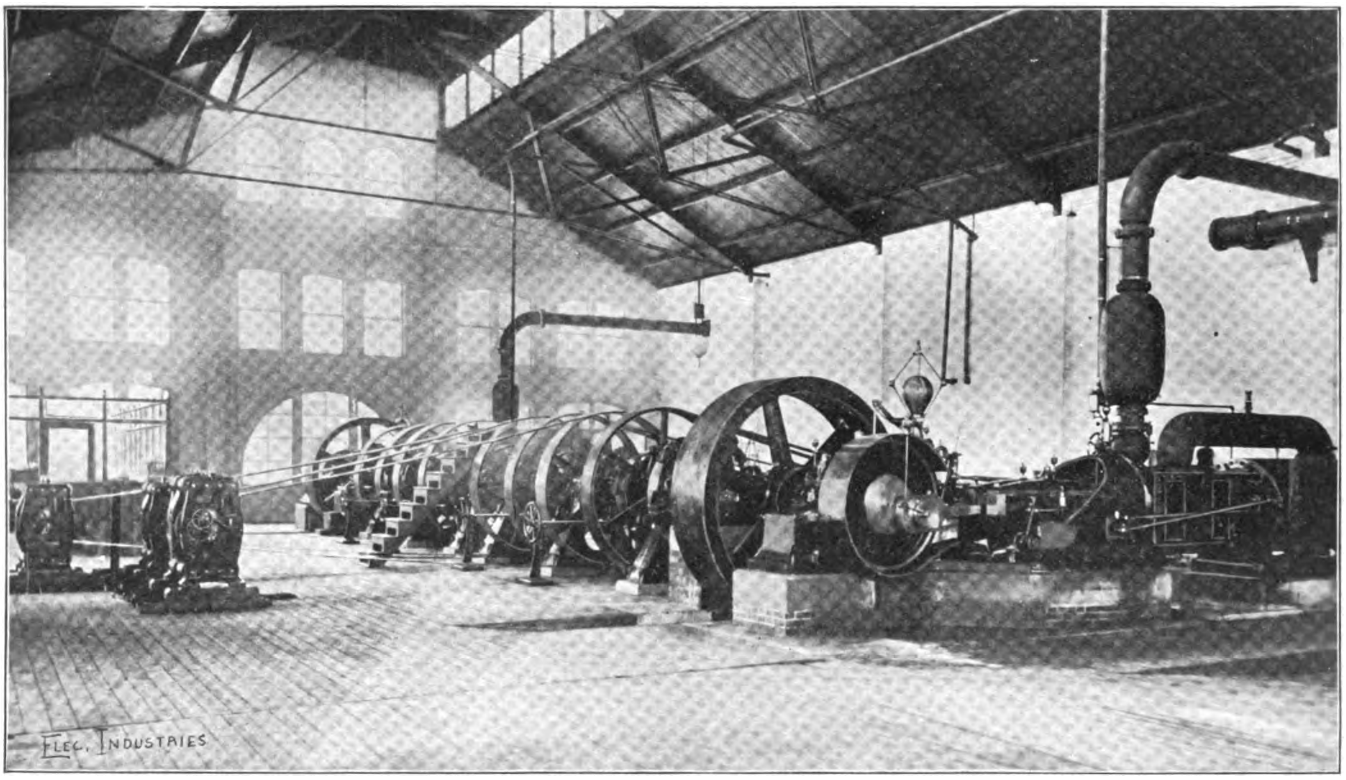


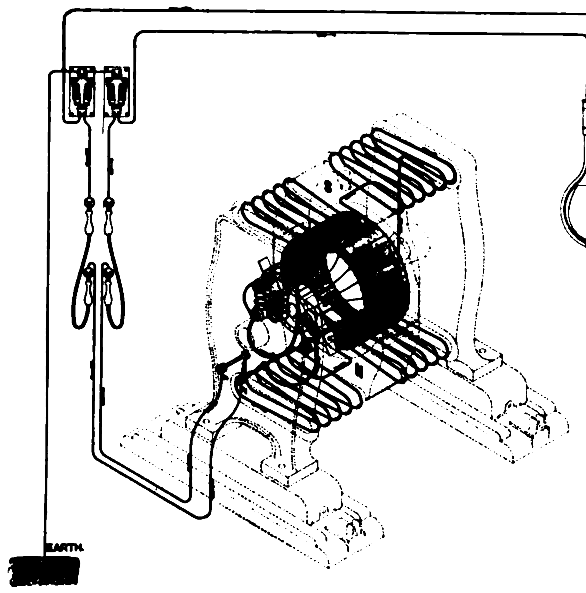
FIG. 1.—THE CENTRAL STATION OF THE PEOPLES ELECTRIC LIGHT AND MOTOR POWER CO.

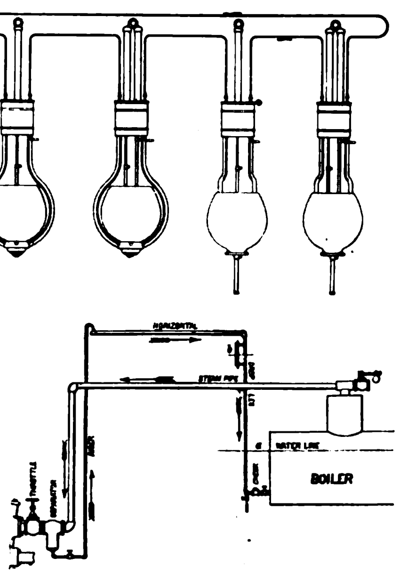
The station is really two buildings with a common partition wall. The engine-room which occupies the whole of one building is 114 by 64 feet. The building occupied by the boilers, economizers, pumps, etc., is 100 by 50 feet. The walls are of brick with large windows and the roof steel truss covered with John's asbestos roofing. Skylights are provided in the roof for additional light. The method of construction gives high, well ventilated ceilings and a practically fireproof building. The design of the building gives a neatly appearing exterior and a wide well-lighted interior. The architect and constructing engineer was John H. Wagner, Chicago. The fuel supply is obtained most conveniently. A siding from the main lines of several mportant roads, which pass within a short distance of the ower station, runs on to the company's property and along the side of the boiler-room, so that coal is delivered directly from the cars into the boiler-room.

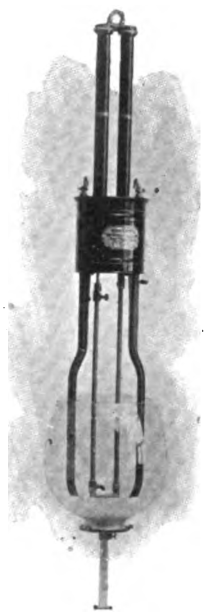
The steam generating part of the equipment has been designed with a view to economy of operation. The boiler plant consists of seven tubular boilers 66 inches by 18 feet, equipped with mechanical stokers. Four of the boilers have Murphy mechanical stoker and the balance Roney stokers. These stokers are shown in detail on page 176. The method of feeding and the distribution of the coal while being consumed are illustrated.

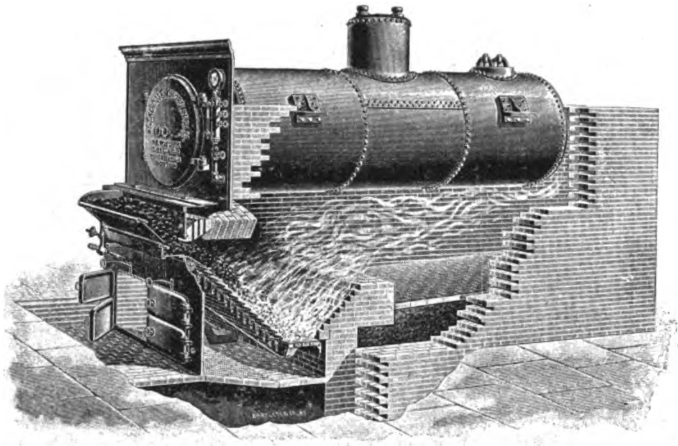
The Roney stoker feeds continuously and in any desired quantity. The fuel is placed in the hopper on the front of the boiler and requires no farther attention. Set in the lower part of the hopper is a pusher to which is attached by a flexible connection, the feed plate forming the bottom of the hopper. The pusher by a vibratory motion, carrying with it the feed plate, gradually forces the fuel over the dead plate and on the grates. These grates consist of horizontal flat surfaced bars running from side to side of the furnace, carried on inclined side bearings extending from the throat of the hopper to the rear and bottom of the ash pit. Each bar rests in a concave seat in the bearer, and is capable of a rocking motion through an adjustable angle.

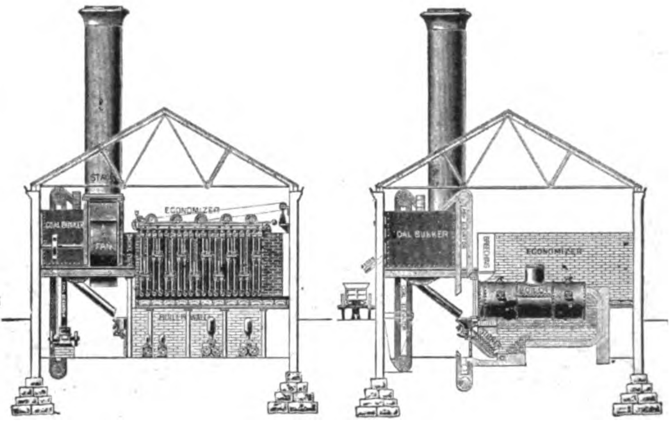
All the grate bars are coupled together by a rocker bar, the notches of which engage with a lug on the low rib of each grate. A back and forth motion is given to the bars and they rock in unison, now forming a series of steps, then approximating an inclined plain with the edges overlaping. When the grates are covered with a bed of coal and fuel is being fed on the grates the rocking motion will cause the fire to work down in a body; but before it has moved far it

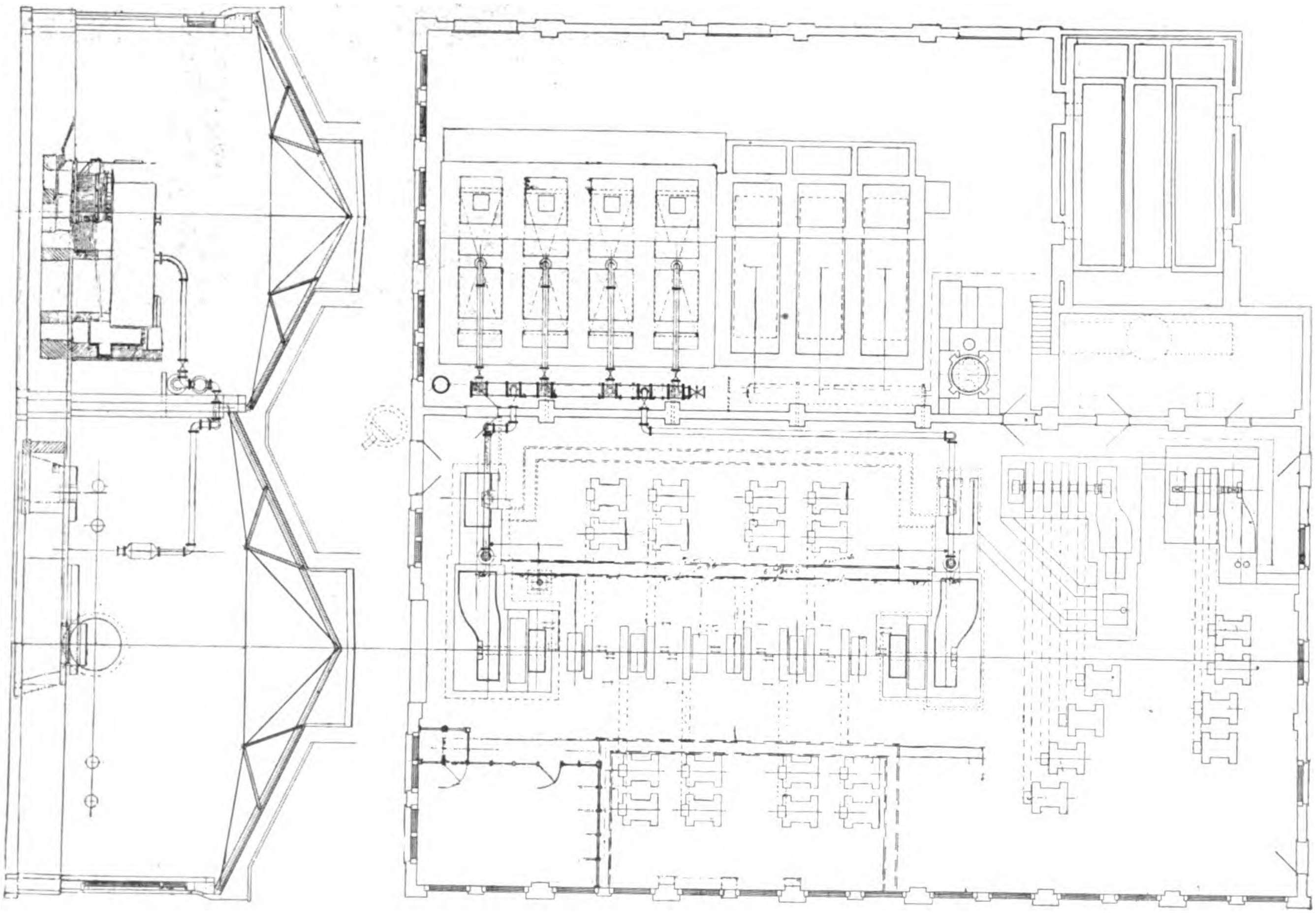












Detail of Arc Dynamo.
The Roney Stoker.
Steamloop System.
Mechanical Draft and Economizer System.
Wood Arc Lamp.
Plan and Elevation of Power House.

THE CENTRAL STATION OF THE PEOPLES ELECTRIC LIGHT AND MOTOR POWER CO.

is rocked back. This motion breaks up the fuel and allows the air to reach the coal. The motion is slow but regular. The alternate starting and checking motion keeps the fuel constantly stirred and broken up. The ash and cinder finally land on the dumping grate below, from which they are thrown into the ash pit. The operation of the stoker consists of a slow but continuous feed, a constant stirring of the fire, and an automatic rejection of the cinder, all of which is performed without opening the fire doors. A small engine attached to the boiler front operates the simple mechanism.

One of the most interesting features of the plant is the mechanical draft and economizer system furnished by Westinghouse, Church, Kerr & Co., Chicago. With this system the waste gases from the boilers, after having all the heat possible absorbed from them by the boilers themselves, pass through the fuel economizer, and thence out of a short steel stack, at the base of which is placed an exhaust fan. By this method, a positive draft is secured, independently of flue gas temperatures, and a large amount of the waste heat returned to the boilers, by utilizing it in heating the feedwater, which passes through the economizer pipes before entering the boiler.

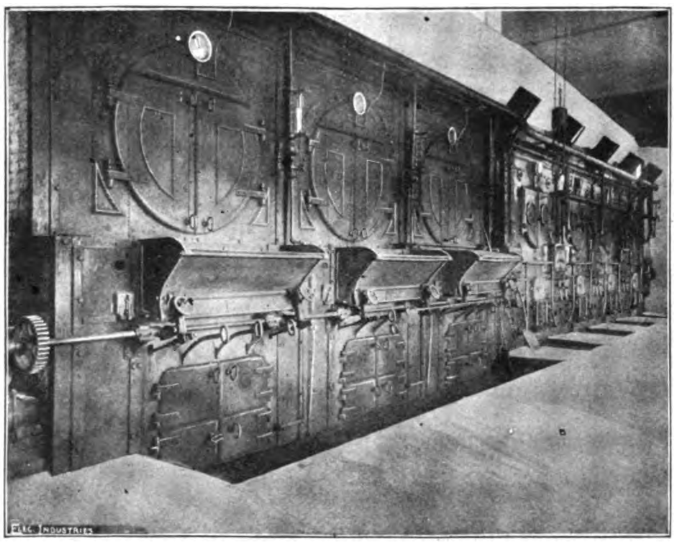


FIG. 2.—THE BOILER PLANT.

The following are a few observations made by Mr. Radford, the chief engineer, indicating the action:

Temp. Feed Water Entering Economizer.	Temp. Feed Water Leaving Economizer.	Temp. of Flue Gases Entering Economizer.	Temp. of Flue Gases Leaving Economizer.
196 deg.	276 deg.	560 deg.	200 deg.
198 "	285 "	440 "	160 "
200 "	280 "	560 "	200 "
200 "	300 "	520 "	180 "

The feedwater first passes through the exhaust heater, which is a 1,200 horse-power Berryman, and even with the high temperature thus obtained, a very fair amount of heat is added to it by the economizer, and the flue temperatures are reduced below what would give sufficient draft with an ordinary chimney. It should be observed that the economizer is small, and especially short for a plant of this size, thus interfering with the best results to be obtained.

The economizer also acts as a purifier to a large degree, and provision is made for conveniently blowing off the sediment collected. In conjunction with the Roney mechanical stokers, also furnished by Westinghouse, Church, Kerr & Co., the system is most complete for preventing smoke, as all soot that happens to escape from the boilers is collected upon the economizer pipes, and automatically scraped in a soot chamber underneath. The short ornamental stack gives a good architectural effect to the building, which, together with the flexible, independent draft, the economy obtained, would seem to give this system the preference over large expensive stacks in the future.

On page 176 is shown the mechanical draft system in detail. Although the plans called for two fans but one was installed. This fan has been in operation since the first plant was started and the second fan has not as yet been needed. This fact, although it speaks well for the fan, should not be considered conclusive that another should not be installed, as a reserve in case of accident to the present fan. The chimney is six feet in diameter and is found of ample size for the escape of the gases when the plant is operated at its maximum capacity. The draft can be regulated as the plant demands. Its flexibillty is one of its important features. The weather and atmosphere conditions do not affect this system. An independent supply of water is at hand so that should the plant be cut off at any time from the city water system the plant will not have to be shut down. Worthington pumps supply the heaters and boilers. These pumps, two in number, are 12 and 14 by 7 by 10.

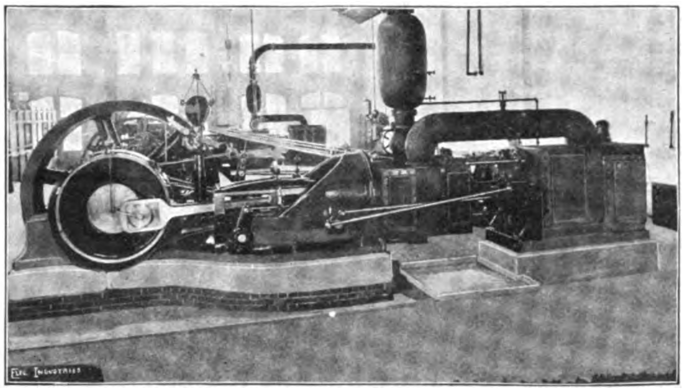


FIG. 3.—THE PORTER-ALLEN 450 H. P. ENGINE.

The engine-roon has been designed with a view to securing the greatest flexibility in the operation of the engines and arc dynamos. The general plan of the station is shown on page 180. The engines are of the Porter-Allen type built by the Southwark Foundry & Machine Co. of Philadelphia. They are four in number; one simple engine of 250 horse-power, one compound of 250 horse-power and two 450 horse-power non-condensing tandem compound.

At the south end of the engine room, is a simple 18 inch by 20 inch engine, running 230 revolutions per minute. The next is a left hand tandem compound non-condensing engine, with cylinders sixteen inches and twenty four inches diameter, and twenty inches stroke. This engine runs 200 revolutions per minute, and is provided with four pulleys, which allows belting direct to four dynamos without the use of tandem belts. At the north end of the engine room, are two 20 and 30 by 24 inch tandem compound non-condensing engines, which run 190 revolutions per minute. These engines are right and left hand respectively.

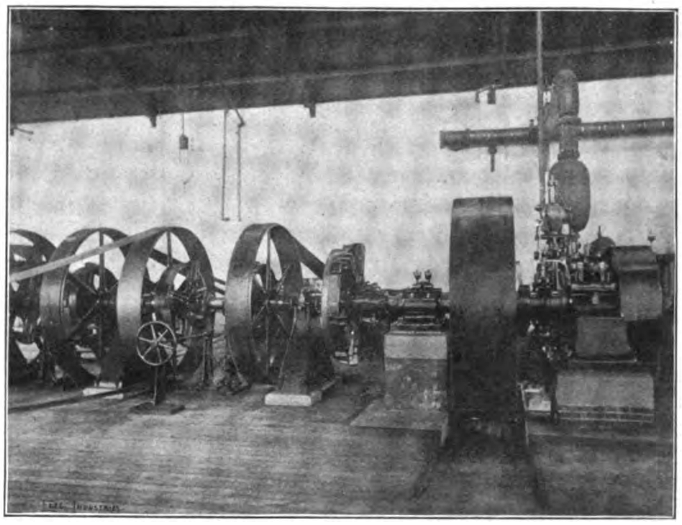


FIG. 4.—SECTION OF SHAFT, SHOWING CLUTCH AND PULLEYS.

In a large arc light station, the above described arrangement of engines and shaft, combines all the advantages of the line shaft and clutch pulleys, making a very flexible plant, at the same time avoiding the great loss of power due to main driving belts and tighteners, necessary where slow speed engines are used. In both the simple and compound engines, each cylinder is fitted with four independent flat balanced valves, two for admission and two for exhaust; the admission valves in the high pressure cylinders are controlled by a Porter governor, which adjusts the cut-off as the load changes.

The distribution of steam in the cylinders obtained by this method, insures high steam economy, as evidenced by the operation of this station, and the perfect balancing of the valves against the pressure of the steam, reduces the power necessary to move the valves, to a minimum, and greatly reduces the wear. The high pressure cylinder in these engines is bolted to the hood of the main bed plate, while the low pressure cylinder rests on an independent sole plate, and is connected to the high pressure cylinder by heavy stay rods. The distance between the cylinders is ample to allow the removal of the high pressure piston without disturbing either cylinder. The bed plate is a single heavy casting extending from the high pressure cylinder, to, and including the main bearing, and bears, throughout its length, upon the foundation. The main bearing is of the quarter box type, adjustable both forward and backward through broad wedges. The guides are of the four bar pattern, making possible a large bearing surface on the crosshead. These engines are of massive proportions, but yet are graceful in outline.

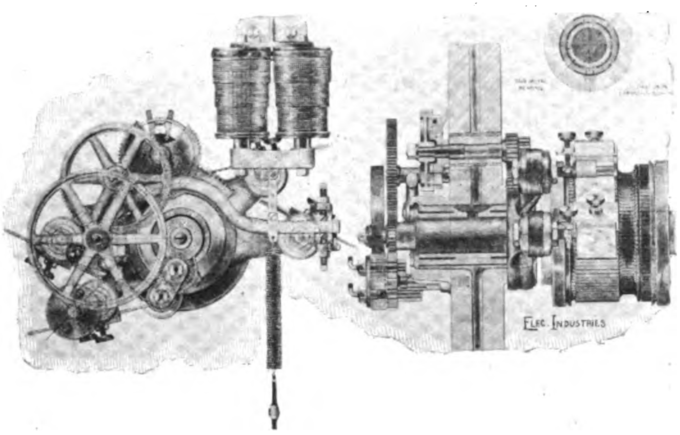


FIG. 5. —DETAIL OF AUTOMATIC REGULATOR FOR WOOD ARC DYNAMO.

Another interesting device in use at this station, is the steamloop and separator system, furnished by Westinghouse, Church, Kerr & Co. By means of this device the water of condensation in the steam lines, is collected and returned directly to the boilers by a simple method of piping, without pumps or traps. Cut on page 176 gives a simple diagram. The particular advantage over other methods are extreme simplicity and the fact that all the condensation is continually drawn from the pipes, and returned to the boilers with almost no loss of heat. With the pipes completely drained at all times, the risk and trouble of water in the engines is entirely eliminated, and a nice saving of heat units procured.

The arrangement of the engines will best be noted by reference to the cut. Two of the engines are connected to separate shafts carrying pulleys from which the dynamos are belted. The two 450 horse-power engines are directly connected to a long shaft provided with friction clutches, clutch pulleys, etc. This shaft is about forty-five feet long, has a clutch at the center and one at each end, so that either a half or the whole may be run by either engine. Each of the eight pulleys on the shaft is provided with a friction clutch so that any pair of machines may be cut out. The dynamos are belted tandem, as the drawing shows. On each crank shaft is a large pulley intended for running an alternator when it is deemed advisable to add incandescent lighting to the present plant.

The shaft, with its bearings, pulleys and clutches was designed and built by the Hill Clutch Works of Cleveland, O., and was installed under the direction of Mr. Coon, the Chicago representative. The clutches are of the six-arm webbed type, such as the trade is generally familiar with. The shaft is designed for 16 arc machines which can all be operated or any part of them at one time. The starting or stopping of a pair of dynamos involvers but the throwing of a clutch. The reserve machines can be made to take the place of one which it is desired to throw out, almost instantly.

The present equipment includes four No. 9 80-light arc dynamos, seven No. 8 75-light arc dynamos and two No. 9 110-light arc dynamos of the well-known Wood type, manufactured by the Ft. Wayne Electric Corporation of Ft. Wayne, Ind. This dynamo is shown in detail on page 176 and as a finished machine in Fig. 6. It has been extensively used and its working qualities are generally known. The windings and connections are shown in the detail drawing. In the insulation long experience has shown the excellence of the methods employed. The brush holders are modern, efficient and durable. An important feature of the dynamo is the automatic regulator which enables the dynamo to be run on any load from one light to even 20 per cent above its rated capacity without any attention. This regulator is clearly shown in Fig. 6 and its detail in Fig. 5. It is so constructed that all wear is compensated for and is perfectly reliable. The controlling magnets are very sensitive and respond instantly to the changes of load. The controller is constructed so that its movement is only as the change of load demands. There is no sudden start that throws the brushes too far and in pulling them back go too far, the result being another attempt. The movement is smooth and positive whatever the change may be.

Another important feature is the patent expansion bearing, which prevents the possibility of the journals becoming overheated so as to stick. Two sections of this bearing are shown in Fig. 5. The construction is such as to prevent the possibility of the accumulation of oil on the field magnets, the waste, if any, running to a drip cup under each end of the dynamo.

The armature has received careful attention at the hands of the designers and builders. The important features, insulation, ventilation, etc., have been well executed. The commutator is constructed in a manner found to be the most efficient and durable. It is composed of narrow strips of copper, insulated from each other by strips of mica, the end being fitted into fireproof and non-shrinkable insulating rings, which are protected by metal flanges. The Wood arc lamp is shown on page 176. It combines the essential features of close regulation, efficiency and durability. It presents as neat an appearance as arc lamps in general. The switchboard is a 21 circuit marble board erected by the Standard Electric Co. It is placed at the side of the engine-room where it is conveniently reached.

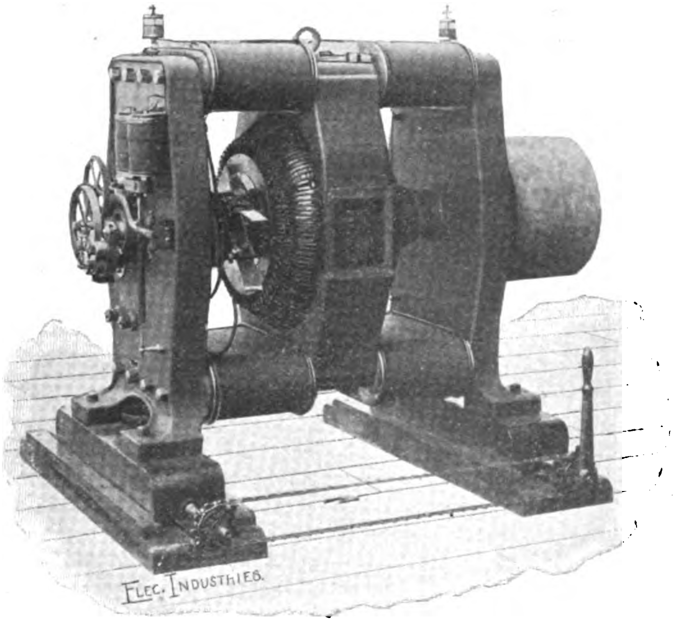


FIG. 6.—THE WOOD ARC DYNAMO OF THE FT. WAYNE ELECTRIC CORPORATION.

Factory Practice in the Design and Construction of Dynamos.—III.

BY C. E. WOODS.

This portion of the work in dynamo designing is something for which no specific formula or rule has ever been given, because the cost of manufacture is generally considered in the computations for the different sizes and kinds of machines. It is desirable, however, to keep the number of turns per sections as low as possible consistent with cost of construction. The ideal number of turns per section would be one, but this would increase the size of the commutator too much in small machines. Another important reason for keeping the number of turns per section low, is because of self-induction in the coils which, if too heavy, will invariably cause sparking at the brushes, that we all know is the very element that must be avoided. Without going into technicalities we will, for the present, assume what practical experience has demonstrated to be a successful issue, and for a 125-volt machine take four turns per section.

Each quarter of the machine must have the same number of conductors in it, otherwise we would have an unequal electrical balance in the armature between the brushes which would of itself cause sparking at the different brushes successively as the armature rotated.

Now, as we need a little room for the driving horns in the armature, that is a solid strip of fiber or some similar substance against which the wires may push without allowing them to slip on the periphery of the armature, we will have, of course, to take a lesser number than 295, which we found in the preceding article to be the number of conductors the armature would hold. We will make the total number of conductors 288, which gives us 72 conductors in each quarter of the armature. If we are to have four turns per section this will also give us a commutator in which we must have 72 segments, to which the conductors will be connected as in Fig. 9. That is, the end of one coil being connected to the beginning of the next, and so on successively around the entire commutator.

We will now make a tabulated summary of what our deductions have brought us so far for the convenience of reference.

Volts	125
Power in kilowatts at 125 volts	15
Power in horse-power	20
No. 16 C. P. 50 Watt lamps at 112 volts	270
Amperes to external circuit	120
Amperes to field	4
Total amperes	124
No. armature circuits	4
Amperes per armature circuit	31
Current density per square inch copper amperes	2,000
Circular mils per amperes	636
Total number of circular mils	716
Circular mils equivalent B. & S. wire	No. 7
Diameter of wire in mils insulated	156
Diameter of armature core	14.875"
Circumference of armature core	46.1"
Number of sections	72
Turns per section	4
Total number of conductors	288
No. layers of wire on core	1
Space occupied by wire	44.9"
Space left for driving horns	1.2"
Revolutions per minute	1,025

We have now ascertained for actual work everything possible until we find out the size of our magnetic circuit; quantities of iron we must have in its different points, and what the total magnetic flux is; magnetic flux meaning the total number of lines of force which must flow in the four magnetic circuits, in order to develop the necessary voltage at the speed given, and we do this by the following formula:

Total magnetic flux, equals voltage multiplied by 10 in the power of 8 (written algebraically 10^8, which indicates that eight 10's are multiplied together) multiplied by 2 for the two complete magnetic circuits, or a figure standing for the number of pair of poles, which result is divided by the total number of conductors multiplied by the speed per second, which in this case would be 17; so writing our equation in straight figures we have $\frac{125\times10^6\times2}{288\times17}$. A full explanation of the figure 10^8 will be given later. The result of this equation is 5,092,000, the magnetic flux, or lines of force, per pole will be one-half of the total, or 2,546,000; and the magnetic flux in the armature core will be one-half of this, which is 1,273,000. As there is some leakage from pole to pole at various points of the circuits we have to increase this amount by such a number that those points in the magnetic circuit shall be large enough to accommodate the lines of force which are wasted by the leakage, that is, which do not pass through the armature core and are cut by its conductors. The loss for a machine of this character is found to be about one-tenth. If we multiply the above number by 1.1 we will increase the number one-tenth, 1.1 being called the coefficient. As this leakage is wholly in the poles the magnetic flux has to be increased one-tenth which will make it 2,800,600. The number of lines of force per square inch which cast-iron will carry will be in a machine of this size, 40,000, and the number of lines of force which we will use in our armature core per square inch will be 60,000, consequently from this we can readily ascertain the nember of square inches which will have to be in the iron at three points of the circuit, namely: poles, armature core, and the iron rim which connects the poles together.

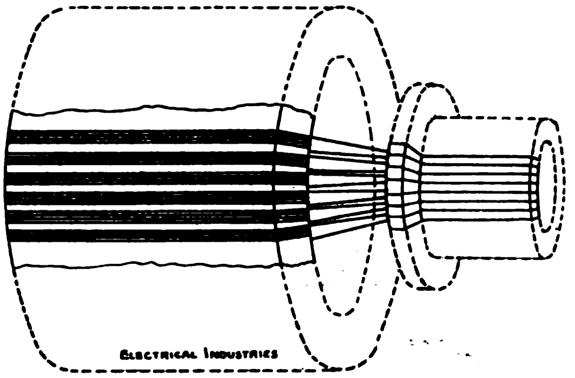


FIG. 9.

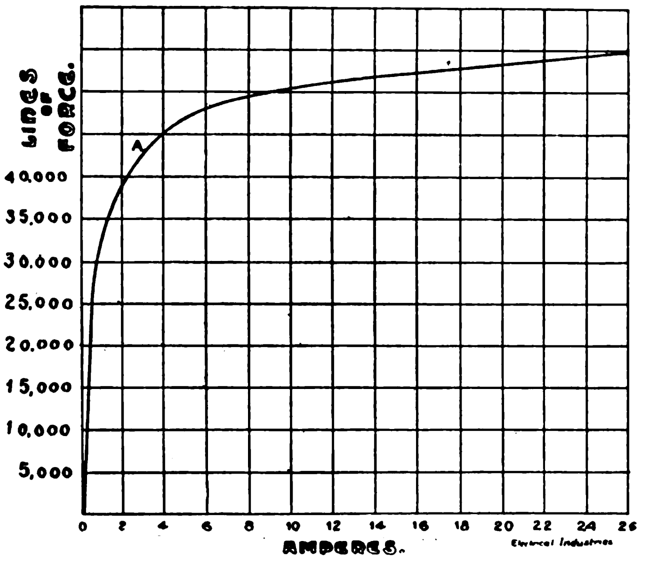


FIG. 10.

The number of lines of force which iron will carry as given here is taken from actual tests on machines that have been made. We might mention here one peculiarity of cast-iron in connection with dynamo designing; as the size of the castings increase in mass their permeability increases also; that is, a greater number of lines of force can be carried per square inch, which is accounted for by the fact that a large body of iron cools much slower in the sand, after being cast, than a small body; consequently this condition in its manufacture anneals the iron giving it more desirable magnetic qualities. In machines as large as

200-horse power and over, the writer has worked the iron as high as 50,000 lines of force per square inch, and at that point it was under the point of saturation, or what is ordinarily termed, working the iron a little under the "knee." A little under the knee is about point "A" in Fig. 10, which is a curve actually taken from a cast-iron machine running arc lights. In that machine, however, the iron was worked at a point much above saturation because of the steadiness gained in a constant current by so doing. But in incandescent machines, or in shunt wound dynamos, it is necessary to work them so that the maximum effort of the shunt and series coil combined will just reach the saturation point at maximum load and effort.

On turning to our figures we find that dividing 2,800,000 by 60,000 lines per square inch demands 70 square inches pole area, and as the rim which holds the poles together should have one-half (½) the cross-section of the pole, that is, that portion of the pole directly over the armature, we need 35 square inches at this point. As we have 1,273,000 lines of force to carry in the armature core, and as we can carry 60,000 lines to the square inch the first number divided by the latter gives us 21.2 square inches, and tabulating the additional figures obtained, for reference, we find:

Total magnetic flux	5,092,000
Magnetic flux per pole	3,546,000
Magnetic flux in armature core	1,273,000
Coefficient	1.1
Magnetic flux per pole plus coefficient	2,800,000
Lines of force per square inch in cast-iron	40,000
Lines of force per square inch in wrought iron armature core	60,000
No. of square inches required in cast-iron pole	70
No. of square inches in cast-iron rim or yoke	35
No. of square inches required in armature core	31.2

The peripheral width of the poles, or its length in the direction of the axis of the armature, is a point which experience alone can teach, but if you are working your armature core not over 60,000 lines of force to the square inch, the peripheral width of the poles, which is the thickness of the poles around the periphery of the armature, can be greater than if the armature core was worked higher; so assuming the length around the armature core is 46 inches, we will first divide this by eight which will give us the width of pole, and space between poles of equal breadth in a four-pole machine, which would be 5.7, but as it is desirable to make the poles a little wider than the space between them, we will make the poles 7 inches peripheral width, that will necessitate their being 10 inches long, which multiplied by seven gives us our 70 square inches. We have now to consider the radial depth of the armature; its length, and length of the poles extending from the rim to the armature.

New York Electrical Underground Conduit System.

In formulating the project for an underground electric system the Metropolitan Traction Company proceeded upon the most conservative lines, and determined to reduce the consequences of failure to the minimum of damage which would inevitably arise from any stoppage in the service. The plan therefore contemplated the construction of the line as if for a cable road, in order that, should the electrical system prove unsuccessful, the electrical portion could be taken out, and the cables and pulleys of a regular cable system introduced into the conduit without loss of time and at comparatively small expense. Upon this basis construction was commenced, and no pains and expense have been omitted to render the installation and operation successful.

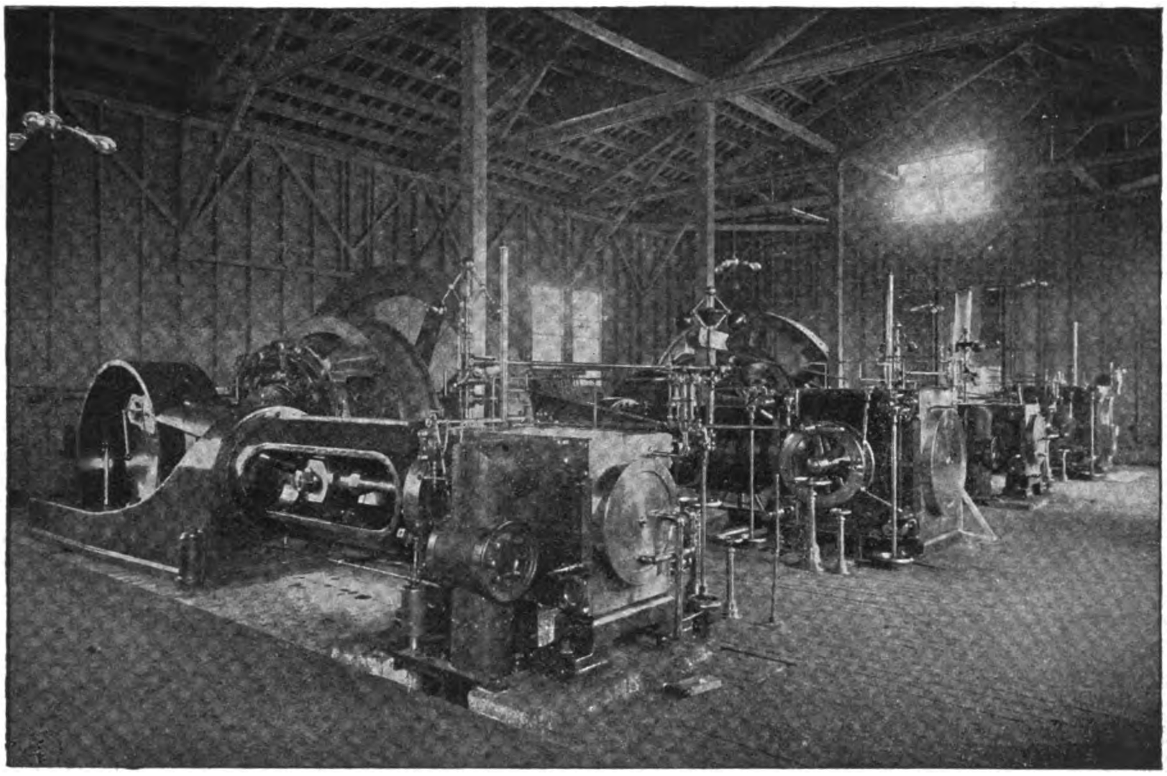


FIG. 1.—NEW YORK ELECTRICAL UNDERGROUND CONDUIT SYSTEM—INTERIOR OF POWER HOUSE.

The Lenox Avenue line is a double-track road, starting at the car house at 146th Street and running directly south to 116th Street into which it turns, and proceeds as far west as Manhattan Avenue. It turns here and runs as far south as 108th Street, along which it is carried to the junction of that street and Columbus Avenue. The district which this line will serve is at present somewhat sparsely settled, but the facilities of transit which will afford will probably result in the rapid development of a new residence section on both this and the other side of the Harlem. The power-house is a temporary frame structure, with a sheathing of corrugated sheet-iron, located on 146th Street, a few yards west of Lenox Avenue. The present power plant consists of two 650-horse-power engines and two 400-kilowatt generators.

Steam is supplied from two Babcock and Wilcox water-tube boilers, arranged in one battery. Each has a rated capacity of 250-horse-power furnishing steam at 120 pounds. The engines are horizontal cross-compound Allis Corliss machines which during the experimental trips will run non-condensing. All the steam piping is placed beneath the floor of the engine room. To each of the engines is coupled a general electrical 400-kilowatt generator of standard construction, but wound for 350 volts, instead of 500 volts as is the usual practice in railway work. This machine is placed between the high and low pressure sides of the engines.

From the generators the cables run beneath the switchboard to a subway, under the sidewalk on 146th Street extending as far as Lenox Avenue, where they are introduced into the five-inch iron pipes, running parallel with the conduit. For the present the line will be operated directly from the power house, but the feed wires will probably be placed in the pipes and will be tapped into the conductor at the necessary points. This line will then be divided up into sections, and its general operation thereby greatly facilitated.

The construction of the underground contact system is simplicity itself. The plough suspended from the car truck passes through the slot in the centre of the track and presses against the flat surfaces of two iron conductors running the entire length of the conduit. These conductors are placed each three inches on each side away from the centre of the slot to avoid deleterious effects of any drip which would otherwise reach them, and are of channel iron four inches deep and thirty feet long. They are suspended from the ceiling of the conduit by means of insulators devised for this especial purpose, and are at a depth of thirteen inches below the conduit slot. Each conductor is sufficiently rigid to require suspension at the ends and centres only, and the ends being located in the man-holes and hand-holes being placed at the centres, inspection and repair are rendered comparatively easy. The conductors are bonded to each other by stranded copper wire securely riveted into the web of the metal.

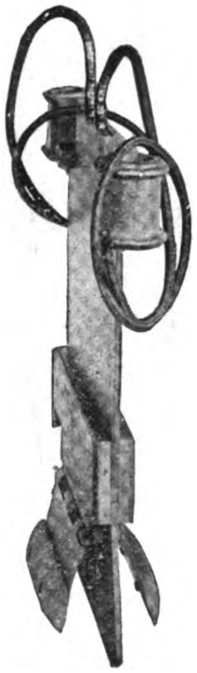


FIG. 2.—THE PLOW OR UNDERGROUND CONTACT.

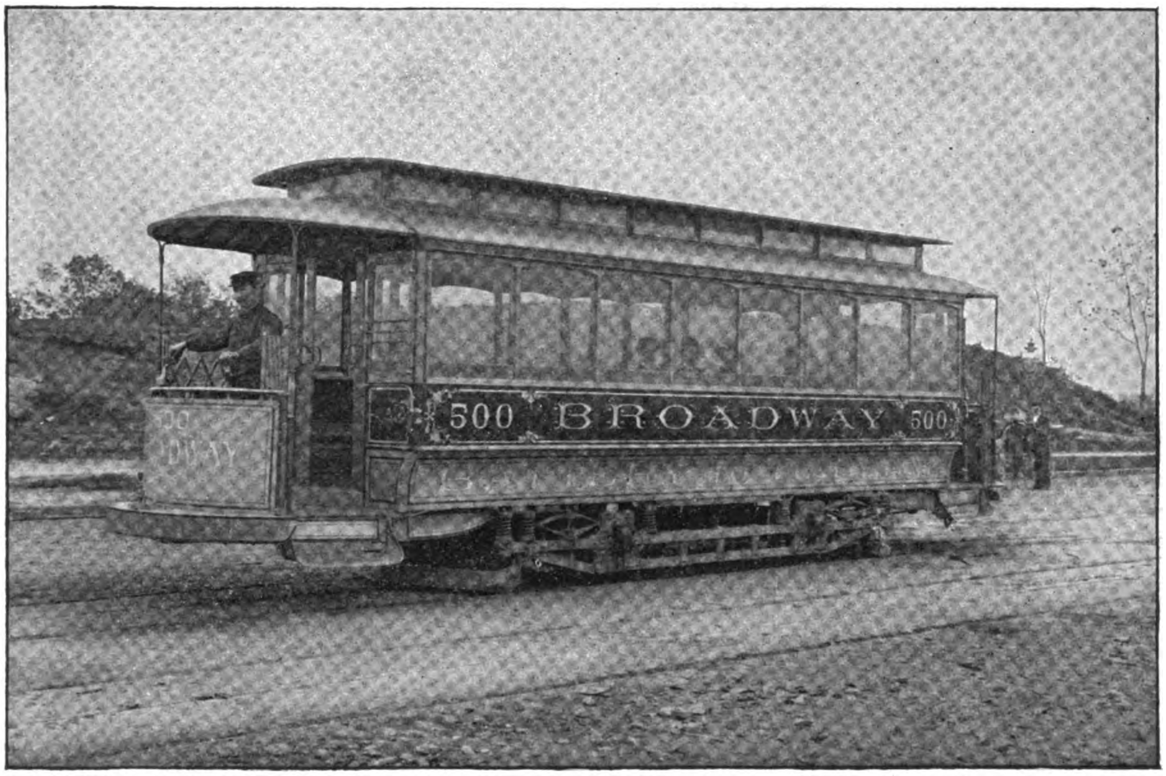


FIG. 3.—NEW YORK ELECTRICAL UNDERGROUND CONDUIT SYSTEM—THE CAR.

A modification of this system of suspension of the conductors is introduced for a length of about one hundred yards single track on 116th street, between Lenox and Seventh avenues. This is known as the pedestal method of support. At the manholes instead of insulators suspended from the ceiling of the conduit, the conductors are supported by a soapstone pillar. The channel bar conductors in this case are five inches deep and are set 12 inches below the slot. The soapstone pillars are provided with iron caps furnished with brackets to which the conductors are bolted, and continuous connection is secured by means of a band of flat copper strips riveted to the webs. The soapstone blocks are set in iron bases erected in the manholes. Every twelfth manhole is connected with the power house by telephone. Quick break switches are located at intervals in these manholes, in order that any section of the line may be cut-out in case of trouble or accident. At the track switches each conductor is provided with a flaring nose, to facilitate the entrance of the plow into the conductors. The manholes in which the insulators are placed are 4 feet, 4 inches in depth, 4 feet in length and 14 feet $5\frac{1}{2}$ inches in width, that is, the entire distance of the two tracks. They are constructed of brick, with 8-inch walls, that rest on concrete foundations. The floors are laid with 6 inches of concrete and are provided with drains for carrying off water. With this provision for drainage no trouble from water in the conduit will, it is believed, be experienced. The conduit was built along the grade of the street but with sufficient pitch to permit any water flowing into the conduit to find its way into the manholes, located every 30 feet, and from thence into the sewers.

The current does not return by means of the rails as is usually the case with the overhead trolley. This is a distinct feature and advantage of the new system. Each conductor forms one side of the working circuit; the current is fed into the positive conductor and returns over the other or negative conductor. The current merely rises on one side of the plough, passes through the controllers into the motors and after performing its duty returns by the other side to the opposite or negative conductor.

The plough or traveling contact arrangement is also essentially novel. It consists of two pieces of iron, one on each side of the plough, supported on spring leaves, which causes them to press outwardly against the two conductors. The plough is suspended from a longitudinal bar bolted to cross beams set upon the track and is constructed of two sheets of steel, laid each one upon a plate of fibre. The two sheets of fibre are then brought together, emclosing strip copper conductors, connected at the top to the motor cables, and at the bottom riveted to two other pieces of sheet steel. These run on each side of the plow and serve as supports for the hinges which carry the sliding contact pieces. A heavy sheet of fibre continues downward and serves to separate these contacts.

The motors employed are the standard General Electric 800 machines, controlled by " K^{2}" controllers."

The cars which are to be used on the line were constructed by the John Stephenson Company and are mounted on standard cable trucks constructed by the Peckham Motor Truck Wheel Co. They resemble those used on the Broadway line. The cars are to be lighted by nine incandescent lamps arranged in groups of three each. A car barn similar in construction to the power-house has been built at the corner of 146th street and Lenox avenue. The building is provided with four tracks and has a storage capacity for about twenty cars. The tracks are provided with pits for the examination of the trolleys and motors.

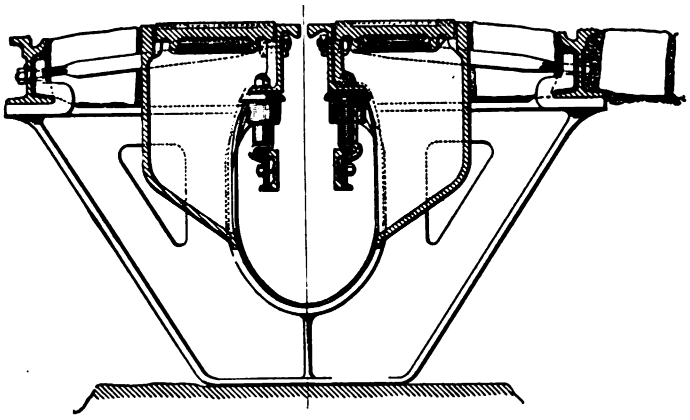


FIG. 4.—SECTION OF CONDUIT—INSULATION SUSPENSION.

The Alternating Current; Its Generation and Distribution.—VII.

GEO. D. SHEPARDSON.

Some means is necessary for the regulation of a dynamo, whether for continuous or for alternating current. The machine may have to deliver a variable amount of energy, or the speed of the engine may vary to some extent. All methods of regulating dynamos are based upon the fact that the one purpose of the dynamo is to generate electro motive force. On constant current circuits such as are used for arc lighting and sometimes for power transmission, the dynamo, the line and all the lamps or motors are connected in series, so that the same current passes through all. It is evident that if the current is to remain constant the pressure or electro motive force sending the current through the circuit must vary with the resistances of the various parts of the whole circuit.

On constant potential circuits, such as are used for incandescent lighting, electric railways and most other power transmission, the lamps and motors are all connected in parallel and each takes its proper amount of current independently of other parts of the circuit. The total current passing from the dynamo to the line will be the sum of the currents in the different lamps and motors. In order to keep the lamps at uniform lightness and the motors at regular speed, it is necessary to keep the voltage or pressure at the terminals of each as constant as possible. The best possible conductors necessarily offer some resistance to the current, and so there is more or less "drop" or loss of pressure on the line. This drop is greater as the current increases, as the length of the line increases, and as the diameter of the wire decreases. It is, therefore, seen that the voltage at the dynamo must vary as the current varies, if the voltage is to be maintained constant at the lamps.

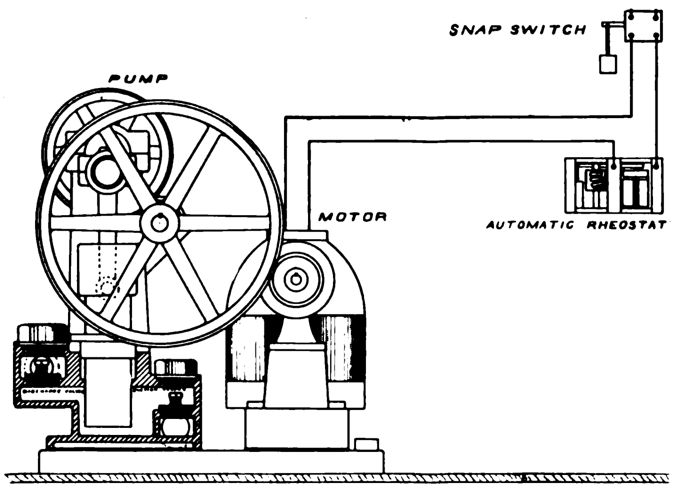


FIG. 1.—ELECTRIC PUMPS FOR GENERAL SERVICE.

There are also certain sources of loss of voltage in the dynamo, which becomes greater as the circuit increases. The armature or generating part of the dynamo itself has more or less resistance which cannot be entirely avoided. The current in the armature also has magnetic effects that generally weaken the useful effect of the field magnets.

A further reason why the electromotive force may be smaller than desired is that the belt is liable to slip, or to creep more or less, so that the speed of the dynamo may be considerably less at heavy load than at light load. Again, many engines run more slowly as the load becomes greater. These are the principal causes that make it necessary to regulate the machine so as to keep the electromotive force constant either at the machine or at the lamps or motors. It is, therefore, necessary to provide some means of raising the total electromotive force of the dynamo as the load becomes greater.

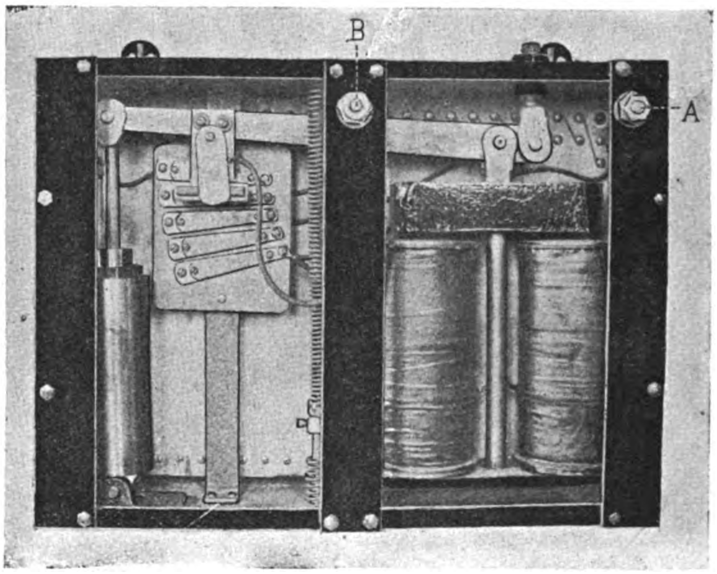


FIG. 2.—ELECTRIC PUMPS FOR GENERAL USE.

As was indicated in an earlier section, the electromotive force of a dynamo is proportional to the product of the speed of the armature, the intensity of the magnetic field and the number of active wires on the armature. Generally it is impracticable to vary the speed of the armature at will, so this method of regulation need not be considered. The number of active wires on the armature may be varied in some continuous current machines, but this is not practicable in alternating current generators as usually constructed. The only way, then, that remains is to regulate the electro motive force by varying the strength of the magnetic field. The common methods of doing this will next be considered.

It sometimes occurs that the insulation between the commutator segments of a generator will be slightly damaged. To take the commutator apart and put new strips of mica in seems a large job to remedy so small a defect. A recent number of the Scientific American contained the following, which is worth trying: "You reply that the only way to repair will be to take the commutator apart and replace the mica. But if he happens to have no appliances for this work, a temporary repair can be made of thick shellac solution and dry plaster of Paris. Fill the crack with the shellac, then put on the plaster, kneading with a knife blade until it is stiff and smooth. Let it dry five or six hours or longer, before scraping off the top even with the surface. It should be thoroughly dry before the armature is used. I have used this method for repairing street railway motor armatures for more than a year, and no armatures have come back in that time for a fault due to this filling.

Electric Pumps for General Service.

The varied applications of electric power are becoming constantly more numerous. Its many advantages over other forms of power, especially where but a small amount of power is desired, gives it the preference. Its convenience, easy regulation, reliability and safety will always commend it. Its economy is not questioned, since the many automatic regulating devices which have been perfected and others constantly appearing, render attendants unnecessary. One of the services for which the electric motor seems to be especially adapted is the operation of pumps, and its use in this respect is constantly extending. City water works, private pumping stations and systems in office and factory buildings have now pumps operated by electric motors, currents being obtained from the central stations.

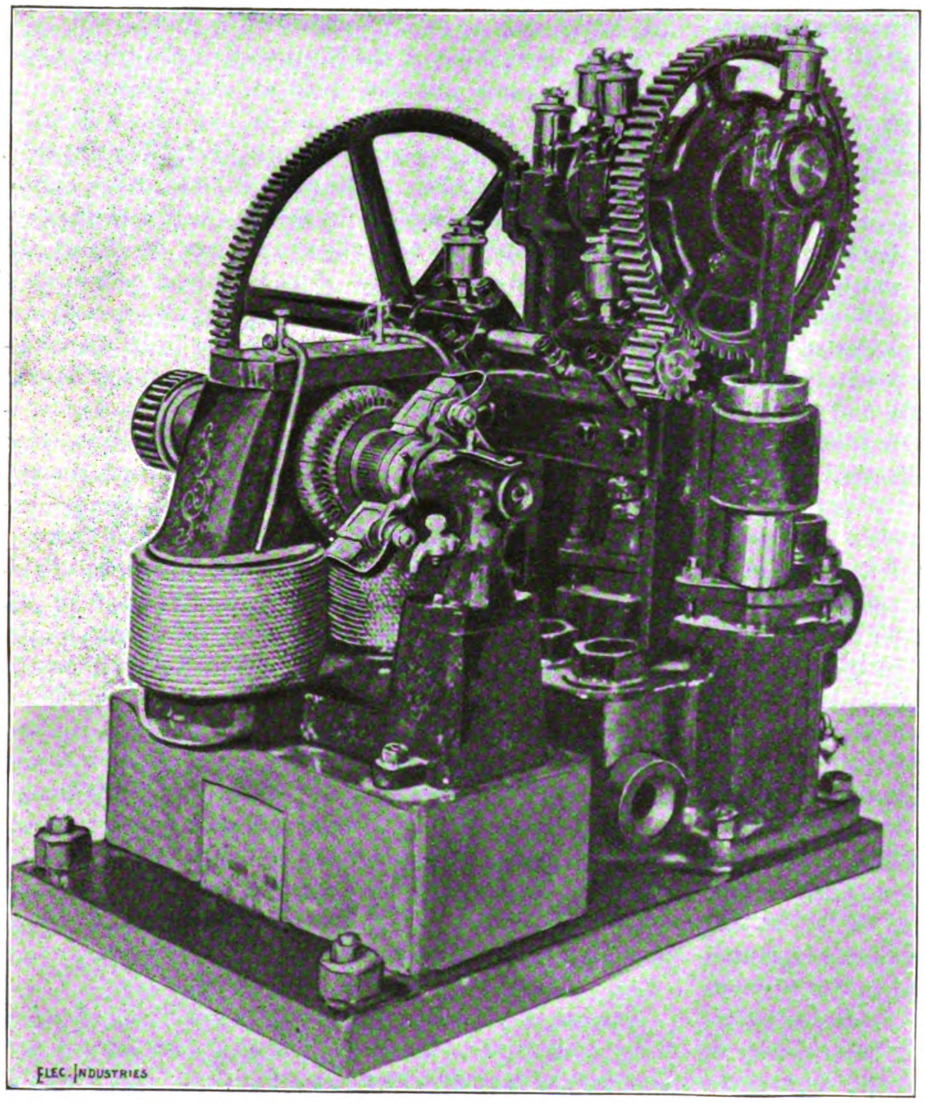


FIG. 3.—ELECTRIC PUMPS FOR GENERAL SERVICE.

Illustrated in the accompanying engraving is a pump and motor mounted upon one base especially designed for office buildings, apartment houses or manufacturing establishments. It has a capacity of 600 gallons per hour. The motor, as will be noticed, is geared directly to the pump. The motor is insulated from the large cast iron sub-base, that supports also the pump, by a heavy hard wood base. The whole combination is firmly fastened to the common sub-base. The pinion on the end of the motor shaft is built up of raw hide which is generally considered the best material for this purpose. The gears are all cut from the solid metal and run so closely that there is very little noise when the pump is working. It is not sufficient to cause the least disturbance to occupants of the building.

The motor is of the bipolar type manufactured by the Keystone Electric Co., and is rated at one horse power. It is strongly constructed, has neat, substantial outlines and requires a minimum amount of attention. The connections to the rheostat are shown in the outline drawing. This rheostat is one of the most notable features of the equipment. It is entirely automatic in operation. When the circuit is broken the rheostat adjusts itself with all the resistance cut in ready for starting the motor. When the circuit is closed the resistance is graduatly cut out as the motor gains speed and load. This device is shown in Fig. 3 which exhibits the electro magnet, the rheostat arm and contacts of the resistance coils.

The circuit is automatically opened and closed by a snap switch which is operated by a floattell tale in the tank in the ordinary way. As the water reaches a certain point the switch is opened, the motor stops and the rheostat arm falls to the position for starting the motor. When the water falls to the low water level in the tank, the switch closes the circuit, the motor starts and the electro magnet gradually raises the rheostat arm cutting out the resistance in which position they remain until the water in the tank again reaches the high water mark. The plant, it will thus be seen, is automatic, requiring no attention while in operation. Only such attention is required as the proper maintenance of machinery demands.

The pump is one of the most modern type manufactured by the Deming Company of Salem, Ohio, which is represented in the west by Messrs. Henion & Hubbell, 61 N. Jefferson St., Chicago. It is of the triplex pattern, having three plungers which insure an almost steady discharge. The double acting pump has two points in each revolution when no water is being discharged, consequently the variation from the maximum flow to no flow is 100 per cent of the discharge. This variation is counteracted in part by air chambers, but the shock or hammer of the moving water injures the pump and absorbs without doing useful work a considerable part of the power. In the triplex pump the variation from uniform discharge is but 15 per cent from maximum to minimum discharge in one revolution of the pump shaft, and almost the entire power is applied to the useful work.

The plungers of this pump are outside guided and outside packed, insuring long life to the apparatus and ease of attention in maintaining it in perfect order. The valves are of a simple type and are easily accessible. A number of these pumps are now in use; some have belted connection, others are geared as described above; changes being made to meet the requirements of the individual case. A very satisfactory service is always maintained and there are few chances for disarrangement of any part of the equipment.

A very serious, although fortunately not a fatal accident, occurred recently at the central station of the Rochester (N. Y.) Gas & Electric Co. Mr. Frank Grover, foreman, was standing near one of the arc machines when he was heard to cry out. He fell to the floor and when several of the employes of the plant reached him he was to all appearances dead. They immediately tried methods for resuscitation and after continuing for a long time the patient showed signs of life. He was taken to the hospital and a few days afterwards was out. When speaking of his experience he could not tell anything about how he received the shock and did not know what had happened until informed by those about him when he returned to consciousness. It is thought that he received nearly 3,000 volts.

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Correspondence, opinions and data bearing upon the practical application of electricity in any of its branches are earnestly desired and will be heartily appreciated.

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The excellence of the June number of Electrical Industries has elicited many complimentary letters from our subscribers. The illustrated articles in which the details of construction were shown and described are particularly mentioned. Such evidence of the appreciation of our efforts to provide a practical paper for practical men is most encouraging and our subscribers will find in subsequent numbers much more elaborate drawings and descriptions of new electrical machines and appliances.

A number of accidents on electric railways during recent months has drawn the attention of the public to the speed at which electric cars are run. The high speed has in several instances been accepted as the cause of the accidents, and the city councils have sought to do their duty by placing a limit to the speed at which cars shall be operated The conclusion as to the causes of the accidents seems to have been arrived at before the conditions of street car service, the increasing demands of rapid transit and the tendency of the times for improvement in transportation, as well as in other lines, were at all considered. If electric cars are only to be operated at the same speed as horse cars, one of their important advantages both to the public and to the company operating them, is lost; modern facilities are not taken advantage of, and such communities might as well have retained the older methods of transportation. Rules as specific as the laws regulating the running of trains on steam roads may well be imposed on electric street railways. Such rules as would regulate signals, precautions at crossings and street intersections, etc., not in any way curtailing the full efficiency of the system, but requiring that proper care be exercised to avoid accidents, would be acceptable to the companies and the public.

While the street railway company should exercise every care to avoid accidents, the entire burden does not rest upon them. The greatest number of accidents has occurred upon those lines whose motive power has been changed comparatively recently from the slow-going horse to electricity. The public, unfamiliar with the higher speed of the cars, has undoubtedly been negligent. A reasonable amount of watchfulness would have prevented many of the accidents, and although the same care is not expected as when crossing a steam road, the highway is but a common thoroughfare over which no one has exclusive rights. Each must exercise a reasonable amount of care so as to protect one's-self and not interfere with the rights of others. The improvement of the equipment of the electric railways, especially in the matter of brakes or means of bringing the car to a stop more quickly, will be the most effective method of preventing accidents. The safety devices and appliances are but in a measure effective. As the public becomes accustomed to the speed of the electric cars and learns more about them, accidents decrease. There will always be, however, careless persons who will take great risks in getting on or off cars or when near them. To protect such persons from accident is one of the most difficult problems to be solved. The same class of persons is met on every system of transportation, but the street railway is least able to handle them.

At the conventions of the Northwestern Electrical Association the close attention paid at each session by its members, to the business before it has been especially noticeable. While the social features and the enjoyment of meeting the members of the same guild are fully appreciated, the main purpose of the meeting is not overlooked. The same enterprise and vigor that has developed the natural wealth and resources of the northwest and made it one of the richest sections of this country is carried into the business of this association. It seems to be characteristic of the people and does not fail in this instance to bring the desired results. The problems and difficulties of central station management are brought before the association for discussion. They are practical problems such as every station manager is liable to meet and a comparison of experiences usually brings out the best methods of turning pounds of coal into watts of electrical energy and delivering it to the consumer, of increasing the patronage of the plant, meeting the competition of other companies, the best methods of construction and hints on the maintenance of the plant, etc. The territory covered by the association being limited the conditions under which the stations operated are quite similar and experiences of one will aid another. The summer meeting held this month at Chicago will probably be largely attended and will, without doubt, be as successful as previous conventions. The absence of one who was always an active participant in the work of the association will be felt with profound regret and sorrow and bring to mind the uncertainty of life's tenure.

The use of electric power has had a beneficial effect on many industries. Each year new combinations and new applications are made, increasing the value that is now generally realized. The manufacturing establishments described in this journal where power is distributed in the form of electricity have shown the practical value either for small factory buildings or manufacturing establishments covering extensive areas. The great increase in the amount of electric power obtained from the central station, adding considerably to the revenue of the station, shows that it is more generally appreciated by the small user of power. Elevators, pumps, printing presses, fans, and the many other machines requiring but a small amount of power are operated more economically in this manner. For the transmission of electric power long distances, the more recently devised systems have enabled the cheaper power of remote districts to be transmitted to the business centers where it finds a ready market. The number of enterprises of this kind, now approaching completion, are attracting the attention of not only the engineering profession but the public at large. As applied to the systems of transportation the electric motor is still advancing. It has gained control of the surface street railways; been adopted on the most recently constructed elevated road, and is receiving the serious attention of the steam roads, especially for the shorter lines. Where the electric motor will be in another five years in transportation is as difficult to determine as it would have been five years ago to have foretold its present position. The progress made is remarkable. The conservative minds of investors usually take up slowly new systems and schemes of inventors, but it has been possible to carry out many plans which would ordinarily have been failures through the belief in the possibilities of everything electrical. It is reasonable to expect that with the confidence gained from past successes and with the same enterprise and perseverance which has characterized the greater undertakings, the progressive engineers will accomplish much to extend the usefulness of electric power.

WHEN the erection of a large city building is contemplated and its various details are considered the question of light and power presents itself, whether it is to be generated in an isolated plant or procured from outside sources. The different sides of this question are considered by Mr. J. E. Talbot in a recent number of the Engineering Magazine. The controlling considerations, he says, that led to the establishment of central stations were the greater economy of the larger units, the longer hours of earning, and the lower cost of operation due to the centralization of business and personnel—the same centralizing tendency which leads to the formation of our much-berated combines, monopolies and trusts. If the number of lamps required is small it would not pay to establish an isolated plant when current may be obtained from the street service; but when the capacity of the plant increases to 100 or 200 horse-power or more the conditions approach those of the central station. Take for an example a city block or square which may contain a population as large as that of a fair sized town. Such a block may contain a hotel, a theater, and express office, a newspaper office and stores of various kinds, as well as a number of light manufacturing industries, so that the power required in the form of electric current for lighting, for motors, and in an increasing degree, for heating and cooking purposes, may easily run up into hundreds of horse-power. The property may be owned by one or a number and be valued at several millions of dollars. Such considerations will modify the conditions of the problem in different cases but in all there will certainly be the requirement of light and in nearly all, that of heat and power for elevators, machines of different kinds, etc. It is necessary that the owner provide a power plant for his tenants. Light may be provided by owner or furnished by the tenant.

THE writer assumes that the owner or combined owners of the block establish a central station within the block for all purposes and adapted to service by the electric current and points out the economical advantages of such a plant. The real estate and buildings are already provided; also steam plant subject to the increase required; fuel, labor, supplies also subject to an increase, are on hand; the wiring and fixtures would in either case be furnished by him. From his tenants he receives an additional revenue which would otherwise go to the gas or electric light company. No figures are given of the additional cost of providing electrical facilities of the kind suggested. At five pounds of coal per horse-power hour and coal at three dollars per ton, the fuel cost would be three-quarters of a cent per horse-power hour which would produce approximately ten 16 candle-power incandescent electric lamps per hour. The additional labor required would be small and with the large force someone would be on duty throughout the 24 hours; extra oil, water and supplies would amount to but a trifle and the buildings would be heated by the exhaust steam from the engine. If electric elevators are used the cost of the hydraulic system is saved. While it is not maintained that all blocks are adapted to such a light and power service, the writer mentions a block in which there are five thousand lights connected; ten elevators are operated by electricity together with printing presses and numerous other machines. A constant load is a great desideratum of every such plant and is more nearly realized in this case than in the usual plant. While the great bulk of the lights are used between four and eleven, there are a great many used all the time. The elevators are in constant use and most of the other motors. During the slack hours from midnight till morning when the number of lights required is very small the printing presses require power so that for the entire twenty-four hours a considerable part of the plant is working.

IN comparing the cost of operating the isolated plant with the central station Mr. Talbot has no definite figures but assumes from various central station data the cost of a kilowatt hour delivered exclusive of dividends and interest at seven cents. The cost of fuel under usual conditions he places at one-quarter or one-fifth of the total operating expenses. In the plant considered no provision has been made for paying dividends on watered stock; no large salaries to superintendents; no wages of inspectors and outside men; nor repairs or maintenance of outside conductors; less taxes and insurance and less repairs. The whole installation would be under the superintendence of the owner or superintendent and changes or repairs would be made at cost by an employe. Tenants would be charged by fixed rate, or lighting might be included in rent; motors would be changed at so much a month or the entire current would be charged at meter rates. The different uses to which the current is put might make a scale of prices desirable since continuous use might be encouraged in that manner. The use of storage batteries to relieve the dynamos during the supposed short period of maximum load is considered advisable in the present state of the art. In conclusion the writer considers it certain that a "block" plant as suggested would in many instances enable complete electric service to be obtained under conditions where otherwise it could not be had or at least not so readily, conveniently or economically.

The line of the Pennsylvania Railroad between Burlington and Mount Holly, N. J., is being equipped for operating by electric power. A little more than five miles of the line has been completed and a trial trip was recently made over this section by officials of the road. The work is being done as an experiment to ascertain the probable cost of equipping and operating by electricity some of the shorter branch lines that at the present time do not pay expenses. If it is found that these lines can be profitably operated by electricity the change will be made.

Rumors are afloat that there is shortly to be a new electrical supply house established in New York, in which Chicago capital will be interested.

The Great Northern Railway Electric Light Installation, Holloway, England.

The site of this generating station is at Holloway, on a plot of land lying between the Great Northern main and suburban lines and the branch line joining these, by means of which access is obtained to Broad Street and the North London Railway system generally. Here, there has for some time existed a large gas works belonging to the Great Northern, and erected for the purpose of making and compressing oil-gas on the Pintsch system for lighting the passenger carriages on this line; and the electric lighting station has been built on an adjacent plot of vacant ground. In the two-story block at the center of the group of buildings there is provided office accommodation for the engineer in charge, and his assistants, stores, workrooms containing a few machine tools (all driven by electric motors, and used in the manufacture or repairs of parts and fittings), a mess-room for the workmen, very comfortably fitted up with cook stove and lavatory; while in the roof are erected a number of galvanized iron water tanks for the boiler supply. The latter are inter-connected with one another and have a total capacity of 7,000 gallons, fed from the New River Company's system by two separate pipes, thus affording a duplicate supply. From a loophole or window on the upper floor of this block there projects a light wrought-iron girder crane, with a traveling crab for lifting heavy stones and other articles from delivery vans below right into the store-room itself.

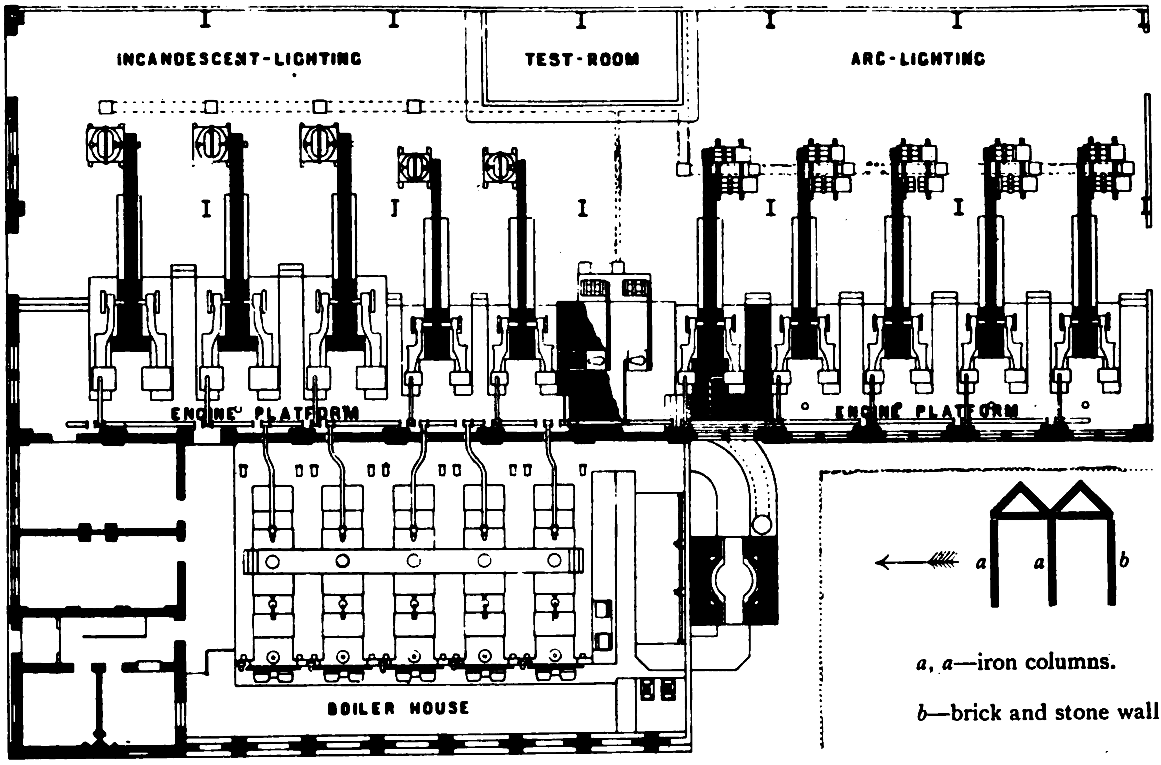


FIG. 1.—THE GREAT NORTHERN RAILWAY ELECTRIC LIGHT INSTALLATION.—PLAN OF STATION.

In the rear of the offices are the two sheds or bays which form the engine and dynamo room, and the statement might safely be ventured that these are the loftiest, airiest, largest, and best ventilated of any electric generating stations in the metropolis for the output involved. Two sides only are of brick and stone-work; the others are merely closed in by corrugated iron walls of a temporary nature, so as to allow of extensions if the demand for current increases above the present limits of the plant. Light iron pillars serve to support the timber and slate roofs, being arranged in two rows, one centrally and the other at the outer side of corrugated iron, as may be gathered from the plan of the entire station (Fig. 1); these columns appear diagrammatically as in the appended diagram. The ease with which extensions may be made in the direction of the arrow is obvious, and this method of construction is worthy of more general use in central station design.

Returning, however, to the other side of the station, some attention must be paid to the arrangements for bringing in the supplies of raw fuel to the boilers. At the side of the boiler house is a short siding upon which the coal wagons are shunted from the adjacent main line. As each one is emptied it is pushed to the end of the siding (a removable swinging stop-block being provided) on to a cross traverser, which passes it to the next siding and thence outwards. There is thus no delay in bringing in fresh supplies of coal by reason of having to shunt the empty wagons out of the first siding as a complete train. The coal is at present shoveled straight out of the wagons into large bunkers or openings in the wall of the boiler-house, which lies parallel to the siding. The present output requires the consumption of at least 85 tons per week, so that the labor of coal handling is not an inconsiderable item.

From these bunkers or pockets the coal passes by gravity into the mechanical stoker hoppers; the latter are of the usual Bennis type, and are fitted to all the five boilers now installed, being operated by one or other of two small vertical engines placed alongside one of the end boilers. The boilers have been constructed by Messrs. Spurr, Inman, and Company, of Wakefield; they are all of steel, and have double flues after the ordinary Lancashire type; the following are their chief dimensions and special features: Length, 28 ft.; diameter of shell, 8 ft.; diameter of flues, 3 ft. 3 in.; total heating surface, about 1,120 sq. ft.; working steam pressure, 125 lbs. per sq. in.; thickness of shell plates, $\frac{11}{16}$ in.: of furnace plates, $\frac{1}{2}$ in.; of cover straps, $\frac{1}{2}$ in.; all the plates are of Siemens-Martin ductile steel. Each boiler is fitted with Hopkinson's "duad" and dead weight safety valves; and the factor of safety in their design is not less than $5\frac{1}{4}$.

From the main flue into which each boiler passes its products of combustion, the waste gases travel either directly to the brick chimney shaft, which is 130 feet high, and 11 feet 6 inches square at the base, or else through one of Green's economizers, diverters being provided to shut this off and open the reserve flue or by-pass when required, and vice versa. The economizer is capable of heating 2,000 gallons of water per hour to a temperature of 250 degrees Fahrenheit, and has a total number of 288 heating tubes, eight pipes in width; it is arranged on the latest principle in three groups of 96 pipes each coupled together with elbows at top and bottom to allow free expansion and contraction to take place. A passage is thus left between each group and round the pipes, offering a decided advantage for examination and cleaning operations. As the boilers are designed for high pressure steam, specially strengthened patterns have been used in their construction. The feed water is delivered into the boilers at a temperature averaging from 250 to 260 degrees Fahrenheit, thus showing a clear saving in fuel of at least 20 per cent. This is not, however, the only advantage claimed to result from the use of an economizer, as a uniform temperature inside the boilers is thereby maintained, reducing to a minimum the effects of alternating expansion and contraction, and preventing leaky joints, so frequently a source of trouble where an intermittent supply of cold feed water is used. In order to save the tubes of the economizer from deterioration due to the admission of very cold water, a jet of steam is blown into the feed water whilst passing through the pumps.

The boilers are fed with hot water by one of two Worthington pumps, no injectors being used at all; each pump is capable of delivering 4,000 gallons per hour against the full boiler pressure of 125 lbs. per square inch. The feed-water supply tube is of the ring form, so that repairs may be carried on without interfering with the water supply. Steam is supplied by means of separate pipes to a large steam pipe ring stretched the entire length of the engine room; from the latter branch pipes are taken first with an upward semicircular bend, then downwards to the various engines, twelve in number. Separate stop valves are provided for each engine on the main steam pipe ring, thus dividing it into distinct sections; and of course the ordinary steam valves are fitted close to the steam chests, as shown in Fig. 2.

All the main engines are of the horizontal componnd condensing type, though not at present worked with condensers; they have been built by Messrs. John Fowler & Company, limited, of Leeds; five of them are used for driving two 50 arc light Brush dynamos each, by means of rope gear; three larger engines are similarly coupled to three A 14 Mordey-Victoria alternators for glow lamp lightning, each set having a capacity of 100 kilowatts. The remaining two engines are identical with those used for the arc lightning, but serve to drive two alternators giving an output of 50 kilowatts each. The ropes used to drive each of the large alternators are eight in number, and one and one-fourth inches, diameter: those for the small alternators are also eight in number, and one inch diameter. The latter size is also used for the arc lighting plants. All the ropes are of cotton, from Dukinfield.

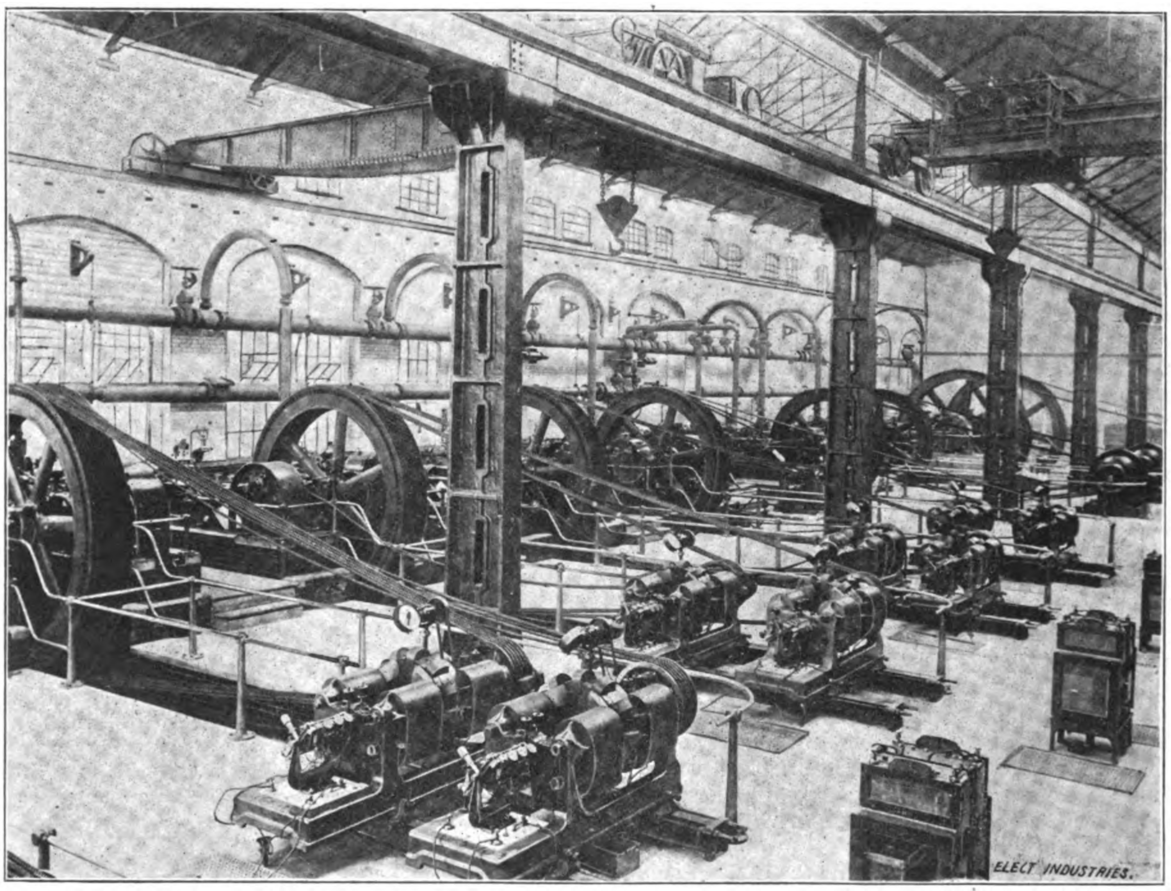


FIG. 2.—THE GREAT NORTHERN RAILWAY ELECTRIC LIGHT INSTALLATION—ENGINE ROOM.

One general description of the engines would serve for all, but the differences in leading dimensions, etc., may best be noted from brief specifications: One hundred horse-power engines: Length of stroke, 20 inches; diameter of high pressure cylinder, 11¾ inches; of low pressure cylinder, 19 inches; revolutions per minute, 120. These engines are fitted with automatic expansion gear to the high-pressure side, and cut-off gear adjustable by hand on the low-pressure side. Two hundred horse-power engines: Length of stroke, 30 inches; diameter of cylinders, 19 and 25 inches respectively; speed, 98 revolutions per minute. These engines are fitted with expansion gear and cut-off as with the smaller type.

As already stated, five of the 100 horse-power engines are employed for driving ten of the latest type of Brush arc lighting dynamos, each having a capacity of 50 lights, run in series with a current of 10 amperes. These machines are set "staggered," so that each may be driven by five out of the ten one-inch cotton ropes on the grooved fly wheel of each engine. The dynamos themselves are of the No. 8 L. type, with laminated armature cores to prevent excessive heating, and consequent waste of energy. Eight only are intended for service at any one time, the remaining two machines and engine being held in reserve. This will secure regular periods of rest and overhaul for each set in turn, even under full load. At present there are about 320 arc lamps operated from the station, the maximum capacity of the plant being 400 arc lights under the above conditions. Eight circuits are run with these machines, and the arc lighting switch-board is so arranged on the multiple system, that any machine may be connected to any circuit, thus giving perfect interchangeability according to the varying loads. A number of the arc lamps are of the Brush type, such as are largely employed in the City of London street lighting, and the rest are principally of the Brockie-Pell form, also used very extensively for street lighting, etc., notably in Portsmouth, Blackpool, etc.

Of minor details in the arc lighting system, the following deserve mention. Regulation of the current (which, of course, requires to be kept as constant as possible) is effected by Brush-Geipel automatic regulators—one for each machine—these are placed in pairs, back to back, in front of the dynamos, and are shown in Fig. 2 at the right-hand lower corner of the engraving. They are of the latest type, employing a pair of carbon plates immersed in water, as the shunt resistance which varies with their depth of immersion. The diagram, Fig. 3, shows the connections and general scheme of this regulator. Lightning arresters of the Brush type are employed in the arc lighting circuits, to protect the machines from possible injury due to the discharge of flashes on the overhead wires, wherever these may be suspended for lighting purposes.

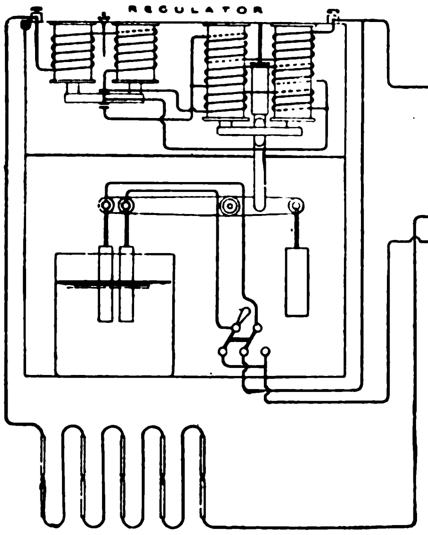


FIG. 3.—THE BRUSH-GEIPEL AUTOMATIC REGULATOR.

The alternating dynamos—five in number, each driven by a separate engine—are excited by means of continuous currents derived from the two Brush-Vienna dynamos placed near the middle of the engine-room, between the arc lighting and alternating plants; they are driven by rope gear from a couple of vertical compound engines, made by Messrs. Browett, Lindley & Company, Limited, Salford, and are shown on the plan immediately opposite the test-room. They indicate 35 horse-power each, run at 280 revolutions per minute, and are fitted with Hartnell fly-wheel governors.

Alongside the test-room is placed a large well-ventilated room, containing an adjustable water resistance, available for use as an artificial load, either for the arc lighting machines or the alternators.

The main alternators and the glow lamp circuits are each provided with a separate switchboard. The total output of the alternating system—which is used solely for glow lighting—is equivalent to a load of 8,000 glow lamps of 16 candle-power each. The alternators are synchronized for parallel running by means of two incandescent lamps which show the engine drivers when the machines are in step; the switchboard attendants use a portable voltmeter for this purpose. The machines are regularly worked in parallel, the special types of governors used on the engines allowing this to be done with perfect ease so far as the prime movers are concerned. The transformers employed to reduce the primary voltage of 2,000 down to the lamp voltage of 110, are made on the Crompton-Brunton patents.

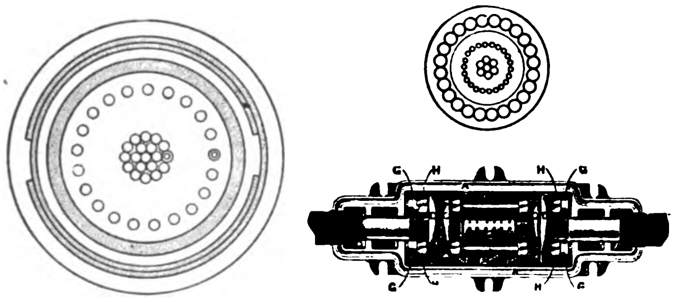


FIG. 4.—CROSS SECTIONS OF CABLES AND CONNECTIONS.

In Fig. 4 is illustrated respectively cross-sections of the alternating and arc lighting cables; these are all of Messrs. Siemens Bros. and Company's make. The glow lamp or alternating current circuits are of concentric cable, lead-cased and armoured. The inner conductor is formed of standard copper wires, insulated with specially treated fibrous material; this inner core is surrounded next by the copper wires of the outer conductor, which has the same total sectional area as the inner. These are again insulated as before, and the whole is then cased in a lead tube, pressed on when cold. The lead tube is served with jute yarn, over which there is a sheathing of hoop iron and steel, externally protected by jute yarn and compound. An insulated test wire is laid in each conductor, and is shown in the engraving by an inner ring. Three sizes of this type of cable are in use, viz.:

No. 400 H C N—0·1 square inch sectional area of conductor; resistance of conductor 0·44 ohm per mile; insulation resistance between conductors 4,000 megohms per mile or 60° Fahr.

No. 300 H C N—0·075 square inch sectional area of conductor; resistance of conductor 0·6 ohm per mile; insulation resistance as No. 400.

No. 200 H C N—0·05 square inch sectional area of conductor; resistance of conductor 0·9 ohm per mile; insulation resistance as No. 400.

For the arc lamp circuits indiarubber cables and wires are used. These comprise the following:

1.—A concentric cable with inner conductor, consisting of a strand of 7 tinned copper wires, No. 16 L S G, insulated with pure and vulcanized indiarubber and taped. The resistance of the conductor is 2 ohms per statute mile, and the insulation resistance between conductors 5,000 megohms per mile.

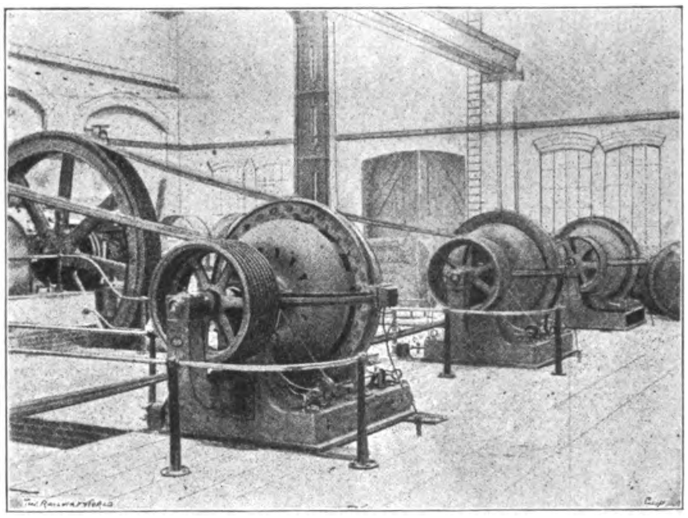


FIG. 5.—THE ALTERNATING PLANT.

2.—A single cable with inner core, the same as No. 1, but served with jute yarn, sheathed with 20 galvanized steel wires, and finished as before. Insulation resistance 3,000 megohms per mile.

3.—A single unarmored cable with similar inner core, but braided. Insulation resistance 3,000 megohms per mile.

In Fig. 4 we illustrate a typical arrangement used with the concentric cables for making a jointed connection. It consists of a longitudinal cast iron box A, in halves, for the protection of the joint; a tinned brass tube B, to connect the two central conductors; and four tinned metal flanges C C D D, with two tinned copper bolts E E, to connect the outer conductors.

The whole of this work has been carried out to the designs and specifications of Mr. A. H. Preece, the consulting engineer for the installation, under the Railway company's own supervision, Mr. J. Hilton being the resident engineer. To the courteous assistance of both of these gentlemen we are indebted for the opportunity of securing the illustrations, and for most of the particulars given in this description.—The Railway World, London.

Storage Battery Work at Armour Institute.

It is one of the special features of the electrical work at Armour Institute, that while the theory is presented in as scientific a manner as possible, it is reinforced by an unusual amount of practical work on the part of the students.

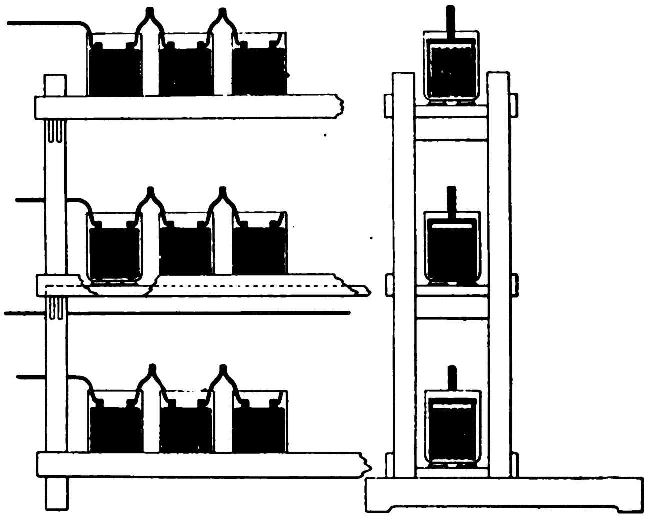


FIG. 1.—STORAGE BATTERY WORK AT ARMOUR INSTITUTE.

Instead of the usual hackneyed examinations, there was recently given one on the subject of the storage battery, which shows clearly how the practical side of the subject was developed. It is given in full because it states many essential facts in regard to the installation and operation of storage battery plants.

The examination as assigned, was:—

(A) To describe and state plan of storage battery room.

(B) To trace out and draw the switch-board connections.

(C) To calculate the resistance for the charging rheostats.

(D) To test some of the cells for their ampere and watt efficiencies.

The plant so studied was one of two storage battery installations in use at the institute. The following is the report for bulletin No. 59 on storage battery installation.

REPORT.

(A) Storage battery room.—The dimensions of the room are 6 feet 10 inches by 15 feet 6 inches by 6 feet in height. The room is built of seasoned pine and substantially floored. It contains two windows four feet by two feet six inches, and a door at one end. There are four ventilator shafts, six by six, in the ceiling, that open into a common way that passes through the wall, and thoroughly ventilates the room. The walls and ceiling are thoroughly painted inside with white lead. This paint is especially adapted to withstand the fumes of sulphuric acid.

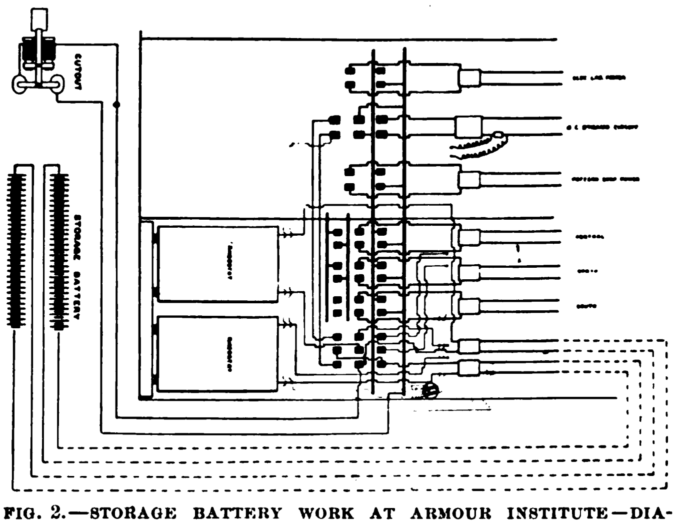


FIG. 2.—STORAGE BATTERY WORK AT ARMOUR INSTITUTE—DIAGRAM OF CIRCUITS.

On the side opposite the windows stands the rack for the cells, as shown in the drawing. The rack is also built of pine, and painted with "P and B" insulating compound. The chief dimensions of the rack are, length, 13 feet 6 inches; height, 5 feet; width, 18 inches. The uprights at the ends and center are three and one-half inches square. The plank on which the cells are placed is one and three-quarters by ten inches. The cells are arranged in three rows of 20 each, connected in two groups of 30 each to the switchboard by separate pairs of leads. The cells are connected by brass bolts through the lead lugs connected to the elements. The containing jars are 10½ by 7½ inches square, and each cell rests on three porcelain insulators, see Fig. X. The mains are No. 4, solid conductor, with okonite insulation, and are bushed with hard rubber tubing where they pass through the wall.

(B) The switchboard.—This is built in three panels, faced with marble, with oak trimmings. On the left-hand panel are placed the switches and instruments for the storage battery. The general dimensions of the board are nine feet six by twelve feet, and is placed with three feet clearance between it and the wall. This space is closed at each end by a door with glass panels. The connections on the back of the board are protected from dust by a framed roof filled with panels of corrugated glass. Openings are left at the top to provide ample ventilation.

All connections are made on the rear of the board, the conductors, if of any length, being strung on porcelain knobs and insulated. The 'bus bars are of bare three-fourth inch square copper rods. The two controlling rheostats for the battery are placed under the connections, just clearing the floor. They are operated by hand wheels on the front of the switchboard. None of their connections are accessible, so the size of wire in their coils was not determined. The switches are bolted directly to the face of the switchboard. The double-throw, three-pole switch to the left is used for battery charge and discharge. There are three instruments placed on the panel. Two ammeters—one on each set of mains for charging, and so connected that the left-hand ammeter indicates the load on discharge. The third instrument is a voltmeter, connected to a six-point, double-pole switch on rear of board. By this switch it can be thrown on either group of 30 cells or on the 60 cells in series. The cut-out, or circuit-breaker, is placed on a bracket on the wall behind the switchboard.

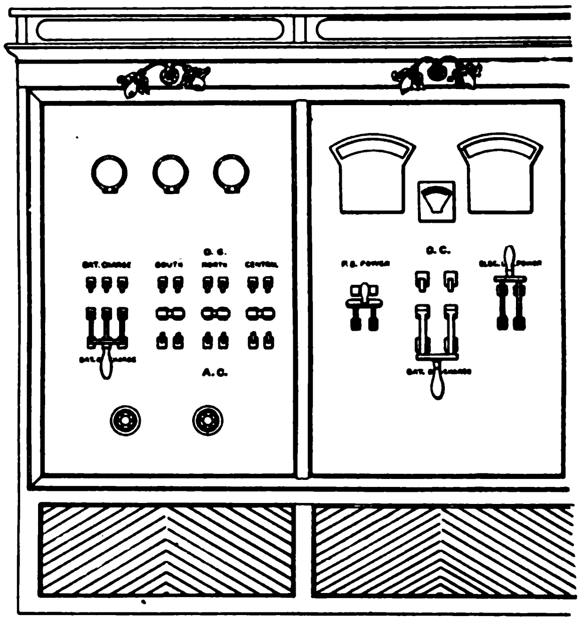


FIG. 3.—STORAGE BATTERY WORK AT ARMOUR INSTITUTE—SWITCHBOARD.

(C) Rheostat calculation.—The rheostats were calculated for each group of 30 cells on charging.

Average counter E. M. F. = $2 \times 30 = 60$ volts.

E. M. F. absorbed by rheostat = $110 - 60 = 50$ volts.

Minimum charging current = 10 amperes.

R of circuit = $\frac{E}{C} = \frac{50}{10} = 5$ ohms.

Resistance of battery = $30 \times .005 = .15$ ohms.

Ohmic resistance for rheostat = $5 - .15 = 4.85$ ohms.

(D). Testing efficiency of storage battery.

Apparatus, Weston ammeter and voltmeter, adjustable resistance.

Demonstration.—Allowed the cell to charge at a 20-ampere rate, keeping the current constant and noticed reading of voltmeter every two minutes for the first hour, and every five minutes for the remainder of the time. The cell was allowed to discharge until the E. M. F. reached 1.7 volts, readings being taken of current and E. M. F. as above. The total watt and ampere hours were then calculated, and the efficiency of the cell obtained.

READINGS TAKEN DURING CHARGING AND DISCHARGING.

CHARGE. DISCHARGE.

Time	Volts	Amp	Time	Volts	Amp	Time	Volts	Amp
8 05	2.24	20	10.10	2.455	20	3 30	2.08	[illegible]
07	2.24		15	2.46		32	2.08	
09	2.25		20	2.46		34	2.06	
11	2.26		25	2.46		36	2.06	
13	2.26		30	2.46		38	2.05	
15	2.27		35	2.46		40	2.04	
17	2.28		40	2.465		42	2.03	
19	2.28		45	2.465		44	2.03	
21	2.29		50	2.47		46	2.03	
23	2.3		55	2.47		48	2.02	
25	2.31		1.	2.47		50	2.02	
27	2.32		05	2.47		52	2.01	
29	2.32		10	2.47		54	2.01	
31	2.33		15	2.47		56	2	
33	2.34		20	2.47		58	2	
35	2.34		25	2.47		4	2	
37	2.35		30	2.47		02	2	
39	2.355		35	2.465		04	2	
41	2.36		40	2.47		06	1.995	
43	2.365		45	2.47		08	1.995	
45	2.375		50	2.47		10	1.995	
47	2.38		55	2.47		12	1.99	
49	2.38		Intermission			14	1.99	
51	2.385		1.15	2.26		16	1.99	
53	2.39		20	2.36		18	1.99	
55	2.39		25	2.41		20	1.99	
57	2.395		30	2.43		22	1.98	
59	2.395		35	2.45		24	1.98	
9.01	2.4		40	2.46		26	1.98	
03	2.4		45	2.46		28	1.98	
05	2.4		50	2.47		30	1.975	
10	2.41		55	2.475		35	1.97	
15	2.42		2.	2.48		40	1.97	
20	2.42		05	2.48		45	1.97	
25	2.425		10	2.48		50	1.96	
30	2.43		15	2.48		55	1.96	
35	2.43		20	2.485		5.	1.955	
40	2.44		25	2.485		05	1.95	
45	2.445		30	2.49		10	1.94	
50	2.445		35	2.49		15	1.94	
55	2.45		40	2.495		20	1.93	
10.	2.455		45	2.5		25	1.93	
05	2.455		50	2.5		30	1.92	
			55	2.5		35	1.92	
			3 05	2.5		40	1.92	
			10	2.5		45	1.92	
			15	2.5		50	1.9	
			20	2.5		55	1.9	
			25	2.5		6	1.89	
			30	2.5		05	1.88	
						10	1.88	
						15	1.88	
						20	1.87	
						25	1.86	
						30	1.85	
						35	1.84	
						40	1.84	
							[illegible]	

DISCHARGE—CONTINUED.

Time	Volts	Amp	Time	Volts	Amp	Time	Volts	Amp
6.45	1.82	20	8.25	1.7	10	9.55	1.83	5
50	1.81		30	1.8		10.00	1.83	
55	1.80		35	1.8		05	1.83	
7 00	1.78		40	1.81		10	1.83	
05	1.76		45	1.82		15	1.83	
10	1.72		50	1.82		20	1.83	
15	1.7		55	1.82		25	1.83	
20	1.72	15	9.00	1.83		30	1.83	
25	1.7		05	1.83		35	1.83	
30	1.76	10	10	1.83		40	1.83	
35	1.76		15	1.83		45	1.81	
40	1.76		20	1.83		50	1.81	
45	1.76		25	1.83		55	1.8	
50	1.76		30	1.83		11 05	1.79	
55	1.75		35	1.83		10	1.79	
8 05	1.74		40	1.83		15	1.79	
10	1.74		45	1.83		20	1.78	
15	1.72		50	1.83		25	1.78	
20	1.72					30	1.78	

Ampere hours charging 121.67

" " discharging 102.09

Efficiency 83.9%

Watt hours charging 4372×6.17=26975.24

" " discharging 2210×8=17680

Efficiency 65.54+ %

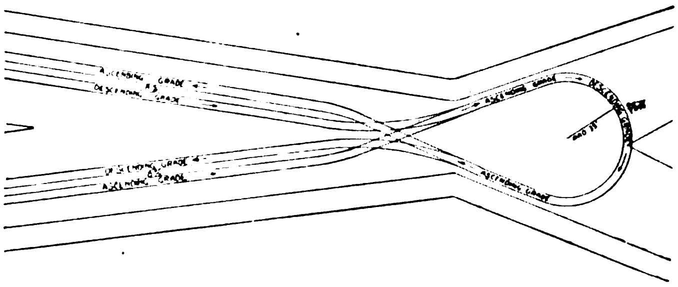
March 20, 1895. Signed Charles T. Malcohnson.

Special Railway Construction.

In but few cities have street railway engineers met the same conditions in the construction of the railway systems. The different ways in which the cities have been laid out due to the different ideas of the founders or peculiar natural conditions have often necessitated special plans and methods of construction. The peculiar ways of city councils and the opposition of antagonistic citizens has often placed the routes of the street car lines most unfavorable to the best construction. The inventive talent of the engineers is taxed to provide means to overcome the new difficulties and the result is not always an ideal arrangement. Physical conditions such as excessive grades, short depressions near old water courses as well as the existing water courses, are met in a variety of ways. The ability of engineers has in nearly every instance been sufficient to provide the special plan for each case.

On the line of the Cincinnati Street Railway Co., a very ngenious loop was constructed on the line up Price Hill. The conditions would usually have been met with a switchback, but the switchback is undesirable for a number of reasons. It would necessitate a stop that is always aggravating to passengers. It reverses the ends of the car and causes the motorman to change, the trolley to be swung, and if the car is fitted with cross seats, the passengers to change positions. The regular cars of the road were fitted to run in but one direction and therefore the considerable expense of further equipment was to be avoided if possible.

By referring to the accompanying cut from the Street Railway Review, the general plan of this balloon curve will at once be understood. Although the curve is a single track and cars both in going down and coming up pass around this curve but one switch was necessary located at the head of the arrow in the cut on the lower side of curve. The cars go around the curve in the same direction so that there is no delay of any kind at this point. The angle at which the two streets come together at this point made a direct turn impossible.



SPECIAL RAILWAY CONSTRUCTION.

Summer Meeting of the Northwestern Electrical Asssociation.

The summer meeting of the Northwestern Electrical Association is to be held at Chicago the 17th, 18th and 19th of this month. The headquarters of the association during the convention will be at the Leland Hotel, corner of Michigan Ave. and Jackson St. The meetings will be held there, and although no definite arrangements have as yet been made, it is expected that some exhibits will be made.

The program has not been completed, but among the list of papers to be read is one by Prof. D. C. Jackson, of the University of Wisconsin, on: 1, "The Choice of Transformers;" 2, "The Advantage to be Derived by Testing Every Transformer Before Placing It on the Line;" and a paper on "Boiler Feed Waters; Their Treatment," by Mr. Willis D. Jameson. The business meetings of the association will be in the morning. The afternoons will be in charge of the local entertainment committee, of which Mr. S. F. B. Morse is chairman.

The program for the afternoons, as now arranged, is as follows: July 17th the power houses of the Chicago Edison Co. and the Metropolitan West Side Elevated Railway will be visited; Thursday, July 18th, the drainage canal will be visited in the afternoon and the Columbia Theater in the evening, and on Friday afternoon the delegates will be driven on Michigan and Drexel Boulevards to Jackson Park. Mr. Wm. Goltz, Milwaukee, secretary of the association, is at work on the regular program, and expects to have it ready for distribution in about two weeks.

Work on the Nantasket Beach line of the New York, New Haven & Hartford R. R. is being pushed rapidly. The track is being rebuilt and the overhead work constructed. The trolley wire is suspended from center poles. Work on the power houses is also being completed as fast as possible.

The West End Railway of Boston has recently placed an order with the General Electric Company, covering two 800 kilowatt, two 1,300 kilowatt and one 1,500 kilowatt generators, all to be directly connected to the engines. This is one of the largest orders for railway generators ever placed at one time, and was secured on the merits of the machines only.

LESSONS IN PRACTICAL ELECTRICITY

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

The Principles of the Alternating Current Transformer.

If we take an iron ring and wind an insulated wire around one side and another wire around the other side as shown in Fig. 1, we shall have one of the simplest forms of an alternating current transformer. If wire A is connected to a battery curcuit with a switch Y, as shown, and wire B connected to a galvanometer, Z, we have the apparatus ready for testing. When the switch is closed there is no indication of a current in the wire B, the same as when the switch is open. The ring, X, becomes a magnet but as its strength is the same while the current is on, there is no perceptible current in the wire B. If, however, we open and close the switch the magnetism of the ring will vary and the galvanometer will show that there is a current flowing in the wire B. We thus have induced currents produced by the increase and diminution of the magnetic lines of force of the ring caused by the periodic flow of the current. The force of the current in coil A is transferred to the coil B.

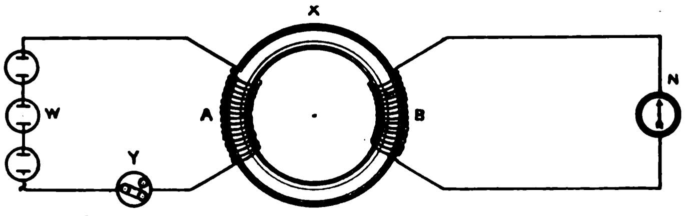


FIG. 1.

If we take the ends of the coil A and reverse their position rapidly on the battery we shall have the current flowing first in one direction and then in the opposite direction in the coil. The effect of this will be to change through a wider range the magnetism of the ring, X. The magnetic lines of force will increase and diminish more rapidly and a greater current will be induced in the coil B. The shape of this ring may be changed as desired. It may be only an iron bar with the coils wound as in A. Fig. 2 or it may be of the shape shown at B. The current induced in the coil B if the ends of the coil were joined and wound on another ring, would induce a current in a third coil if it were wound on that ring. These induction coils might be called "transferers" of current since the energy of one coil is developed into magnetism and the magnetism into electricity in the second coil, etc.

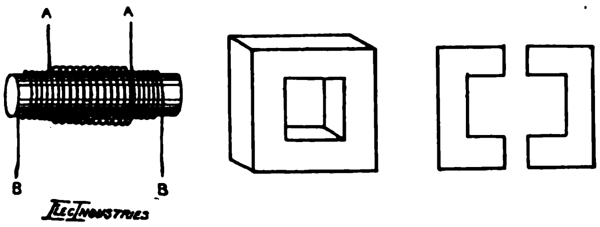


FIG. 2.—A. B. AND C.

The construction of the alternating current transformers is based upon the above principles which were discovered in experiments similar to the above made by Faraday. The ring or core, as it is called in the transformer, has been considerably changed. It was found that a large part of the energy was lost in currents produced in the core when built of a single piece of iron, so the core is built up similar to the armature cores of dynamos. Thin sheet iron, C, Fig. 2, is cut in pieces just the shape of the core and enough of them are piled together to make a core of the right size. The coils of wire are then wound on the core until every part is covered with several thicknesses.

Further experiments developed the fact that any desired voltage might be obtained in the secondary coil by changing the winding. The voltage of the currents in the two coils is proportional to the winding and the currents inversily proportional. The primary is usually wound with a large number of turns of fine copper wire and the secondary with a smaller number of turns of larger wire. If the voltage of the primary is 2,000 and the voltage desired of the secondary 100 the windings will be a ratio of 20 to 1. If the primary carries five amperes the secondary will carry 100, the number of watts being very nearly the same in either case.

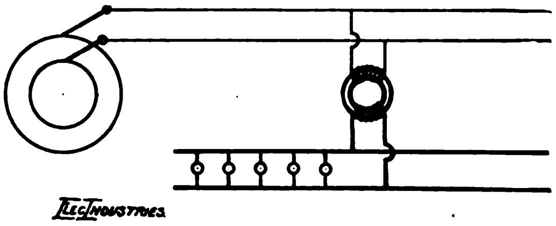


FIG. 3.

When a transformer is connected on a lighting circuit the primary terminals being connected to the mains the primary coil acts as a choke coil if no lights are burning on the secondary. If a few lights are burning on the secondary it acts partly as a choke coil and partly as a working coil, and when its full capacity is on it acts only as a working coil. The transformer is almost entirely self regulating.

Storage Batteries and their Construction—V.

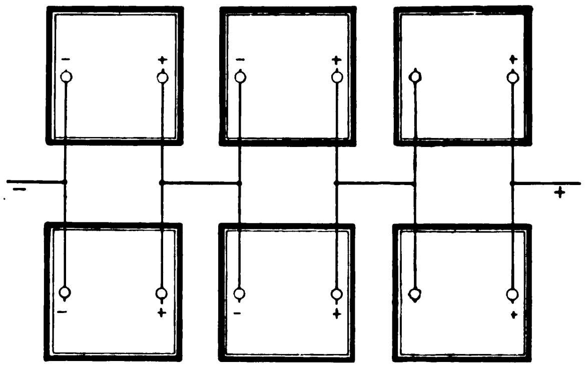
BY J. K. PUMPELLY.

In our last article we left the actual construction of batteries to consider the operation of a set of batteries already constructed and set up by competent persons. The plant was connected up in such a way that the charging and discharging was straight work, that is, the dynamo has only to produce the proper difference of potential and current enough to charge the batteries for a sufficient number of hours. After this work is done, the dynamo is shut down. The batteries are then depended upon to furnish current to such a number of incandescent lamps as may be needed, the load being estimated in proportion to the capacity of the battery. For instance, 30 lamps to burn ten hours if 110 volt, 16 candle power lamps were used, consuming one half ampere each per hour, would draw from the battery 15 amperes per hour; hence a 150 ampere hour battery would be needed which could be charged with a 20 ampere current if necessary in eight hours.

Such a plant is in most cases either a convenience or a luxury, but seldom considered economical as the dynamo and engine are run for the purpose alone of charging the battery, which amounts to converting energy twice over, always at a loss. Against this loss, however, may be placed the convenience of running machinery for charging in the daylight, and being able to gain the result of the converted energy at night. If, however, the plan is to add economy to convenience, then as in a large apartment building where incandescent lights are furnished to the many rooms directly from the dynamo until a late hour and fewer lights during the remainder of the night such as in the halls, offices, etc., economy depends on being able to spare the current for charging the batteries during the day, while furnishing current for other purposes. It seldom happens, in a plant of this kind that all the lights, for which the engine and dynamos are designed, are needed the full time. The batteries can then be charged during the periods of light load at trifling additional expense. It is well known to engineers that the expense per unit of operating a steam driven dynamo is much greater under a light load than under a full load. Mr. Howell in a recent paper gives a table of efficiencies at various loads. When the engine is working at 20 per cent of its full load the water evaporated per unit is more than twice as much as when fully loaded. It will thus be seen that the addition of the battery to the load will not add greatly to the expense of operation. So storage batteries take the place of the lamps shut off, and in storing the current which would otherwise be wasted on resistance wires producing heat not needed, can be made to do the work of lighting, after the engine is shut down.

The 55 cells of battery needing 132 volts to charge cannot be charged by the dynamo which is at the same time carrying a certain number of 110-volt lamps, since the increased voltage necessary to charge the batteries would burn out the lamps. Several plans have been adopted to avoid this. One is to divide 56 batteries into two series, 28 in each, and charge them in parallel. They would in this case, as a series of 28 double batteries need but 70 volts to charge them and will to absorb twice the amount of current. For instance, suppose the plant is composed of 56, 150 ampere hour cells, using 15 amperes for ten hours to fill them. If we throw them in two parallel series of 28 cells, by connecting the two positive terminals of the series of 28 to the positive pole of the dynamo, and the two negatives to the negative pole of the dynamo we really have a battery of 28 cells, but of double capacity or 300 ampere hours, and susceptible of receiving a charge of 30 amperes for ten hours.

Both these series can by proper switch connections, be thrown into a single series of 56 cells, when the charging is over, and then with the aid of a slight resistance, to control for a time the extra voltage of the last added cell we can burn the night lamps that are part of the house plant. We can not, however, burn lamps from the battery at the same time that we are charging in parallel, as the two series would be short circuited. Where, however, such an arrangement is needed, that is, the possibility of using the partially stored batteries as an aid to the dynamo under extra load, a booster is used. This is a small dynamo of sufficient voltage and capacity to generate the needed 28 volts added to the 110 to charge the batteries. This dynamo is in series with the main generator, and can be run by a belt from the flywheel of the engine, or a motor and dynamo on one shaft which can be run by current of sufficient quantity and pressure from the main line to the motor which will drive the small dynamo. This plan is a modern one, comparatively speaking, but more expensive than the other. The connecting of cells in parallel can be better understood by reference to the cut.



BATTERIES IN MULTIPLE SERIES.

Another Story of the Arc Lamp.

"That, man, is the light of the future!"

"That is electricity! I am going to light the world with it!"

These were the words of a big, broad shouldered young fellow of twenty-eight. They were uttered about eighteen years ago to an old man who stood in front of a shop on one of the side streets of the city of Cleveland, and looked with wonder on a glass globe in which blazed a ball of fire, upheld, as it were, between two black carbons the size of your little finger. The old man was A. C. Baldwin, of Tiffin, generally known throughout Northern Ohio as Old Uncle Baldwin, and noted for his great common sense and shrewd business ability. He had made a fortune out of manufacturing churns, and he was now passing through Cleveland on his way to visit one of his relatives there.

He had left the depot and was walking through the streets. It was in the early evening, and the gas lamps cast their flickering rays upon the pavement. In one spot, however, there was a glare of light which came from this ball of fire in the glass globe. It was before the days of electric lighting, and old Uncle Baldwin stopped and gazed at it in open-mouthed wonder. As he did so this big, broad shouldered young man came to the door. His brawny arms were bare to the elbow. A leather apron covered his chest and fell to his knees. His hands were blackened and his face was smudged with dirt. But his eye was bright, and his athletic form was the personification of vigor and force. As Uncle Baldwin saw him he said:

"That is a wonderful light. I don't understand it. What is it? There is no pipe for gas! Where is the wick and where is the oil? Say, what is it, anyhow?"

Then came the reply:

"That is the light of the future. That is electricity! I am going to light the world with it!"

The old man, for a very sharp old man he was, became interested at once. He inquired how the light was produced. He asked many questions as to its cost, and before he left had told the young man that he would take $500 worth of stock in his company, which had been organized to push the invention. He rather hugged himself over his investment, as he left the young man and his ball of fire, and when a half hour later he found himself in the home of his friends, surrounded by some of the most prominent people of Cleveland, he could not rest until he told of the wonder he had seen and of the stock which he had secured. As he spoke the crowd burst into laughter, and Uncle Baldwin's relative, then and now one of the most influential men of Cleveland, said,—

"Well! well! well! And so you have been taken in by that young fellow Brush and his crazy ideas about electricity. I have had dozens of chances to buy his stock, but I wouldn't give a cent for a thousand shares. Why, Uncle, the man is crazy. His ideas are impracticable and impossible of execution, and you might as well put your $500 into Lake Erie as to give it to him." And so the Cleveland man went on. He cited the noted capitalists of Cleveland who would have nothing to do with Brush's invention, and he finally persuaded Uncle Baldwin that he had made a mistake.

The result was he withdrew his offer. As he came to the door the young man looked up from his bench and said:

"I suppose you have come to back out of your proposition as to that stock. That is the way they all do. But, I tell you, you are making a great mistake, and you are losing a fortune."

It was not many years before Uncle Baldwin realized how great a fortune he had lost. Within twelve months after his refusal the name of Charles F. Brush, the great Cleveland electrician, was on every one's tongue. His light had been shown at the Franklin Institute in Philadelphia. It had surprised the scientists of the world in the great electrical exposition at Paris, and the French government had decorated him a Chevalier of the Legion of Honor for his achievement. A great company had been organized to operate his inventions. The Brush stock had doubled and quadrupled over and over again until Uncle Baldwin's $500 worth was of more value than all the savings and speculations of a lifetime. The prophecy of the young man had been fulfilled. His light of the future had become the light of the present, and today he has lighted the world with it. The streets of the biggest cities of every continent blaze at midnight through the genius of Charles F. Brush.—New York Herald.

Electric Pumping Plant for City of Oregon, Ill.

The city of Oregon, Ill., has recently closed contracts for both an electric pumping plant and also for its operation. The city will save fifty per cent of the present cost of operating the water works. The Gould Company, Chicago, will furnish the pumping plant using general electric motors and the central station at Oregon will operate the plant at seventy-five dollars per month. There was described and illustrated in a recent number of ELECTRICAL INDUSTRIES a similar plant at DeKalb, which is proving very economical for the city. The operation of water works by central station companies seems to be profitable for both parties concerned.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

The Moyes Combine Safety Water Tube Boiler.

The accompanying illustrations show an exterior and an interior view of the Combine safety water tube boiler patented and manufactured by Mr. L. M. Moyes, of 413 Walnut St., Philadelphia. While the cuts show the general plan of the boiler, a few facts regarding its important features may be of interest. Regarding the circulation of the water in the boiler broad claims are made for continuous circulation throughout the entire system of water tubes and drums. The fronts of the boilers are of cast iron, of handsome design and are supported entirely free of the brickwork around the boiler. The frame upon which the steam drums rest is formed of I-beams braced and tied so as to be self-supporting, and is also independent and separate from the brickwork.

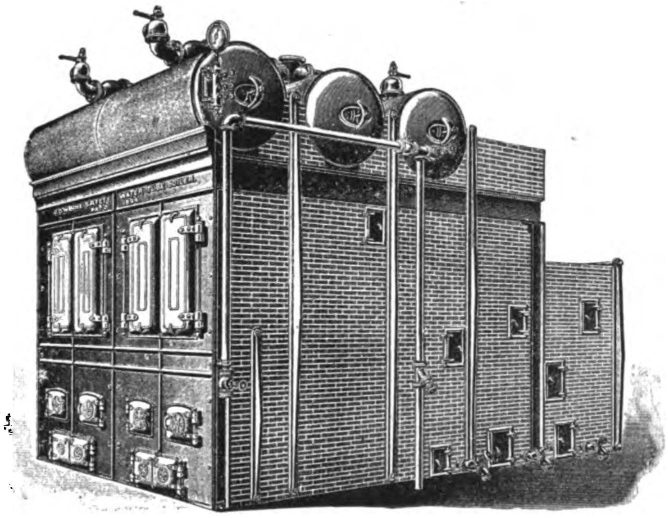


FIG. 1.—THE MOYES COMBINE SAFETY WATER TUBE BOILER.

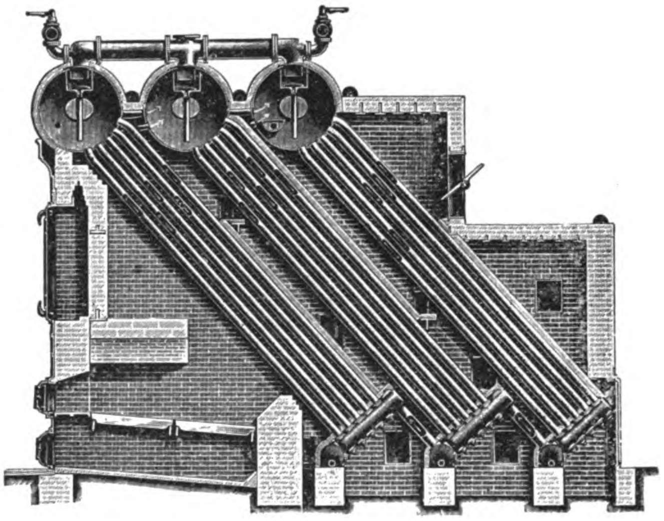


FIG. 2.—THE MOYES COMBINE SAFETY WATER TUBE BOILER.

The side elevation presents a fairly good idea of the arrangement of the boiler. The tubes (standard 4″ x 18′) on an angle of about 45 degrees are expanded at the upper end into the tube sheet into the steam drum, and at the lower end into the tube seats in the "manifolds." The manifolds for power plants are open hearth cast steel thoroughly annealed, making this section of the boilers stronger and more enduring than forging; each manifold has an area almost equal to an eight inch tube. Opposite each tube is a hand-hole closed with an inside and outside plate also of steel, the seat on the outside face of the manifold and the face of the outside plate being machined so as to form a perfect joint without packing. The inside plate forms an almost perfect joint without packing, thereby removing all pressure from the outside joint. Each manifold is connected to the distributing drum by a 5″ nipple; for ordinary high pressure the distributing drums are also steel annealed. The sections are connected to and with each other by circulating tubes set at the same angle as the tubes, and are 5″ in diameter; each distributing drum has a separate blow-off valve.

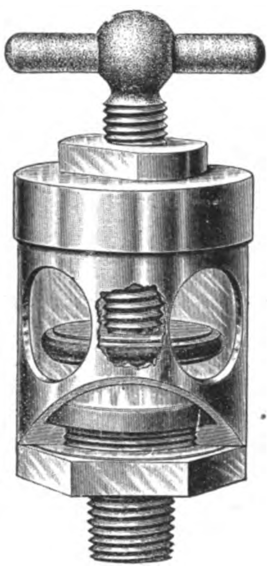
In the operation of the boiler the gases as will readily be seen, have a very long contact with the heating surfaces in their flow from furnace to outtake. As indicated by the arrows, the circulation of water and flow of steam generated in the tube is upwards in the two forward sections into the two front drums, with ample disengaging space; thence, by the connecting devices to the rear drum (into which the feed is also being delivered) downwards in the rear section to supply.

The many ingenious and mechanically designed connections between sections provide for every possible strain due to expansions. The steam drums rest (not suspended) on I-beams in such manner as to remove all carrying strains from the tubes. The transverse section through the front steam drum shows the separator dry pipe in each drum. The section through the rear drum shows the feed water sump; the feed pipe is connected to the sump and into it the feed water is delivered. The sump is of cast iron, on which is placed loosely a light cast iron cover, which continues to within a short distance of the end of the sump, forcing the feed to travel its entire length, and in so doing acquiring the temperature of the water in circulation in the boiler before coming in contact with the same, thereby depositing many of the impurities in solution, and suspension, which is removed by the use of the blow-off valve attached for that purpose. Should the deposit in the sump accumulate through inattention to such an extent as might interfere with the passage of the feed, the cover, being placed on loosely, would be forced off by the accumulating pressure, due to the feed delivery, and thus enable the feed to enter into circulation. The circulating and compensating tubes by which the steam drums are connected, are shown in the side elevation, Fig. 2; also the cross steam pipes on top of the drums; to which are attached the safety valves. These cross pipes are of "steel" with flanges cast on.

Forethought is displayed in the facilities for the removal and replacement of damaged tubes. A tube from any section in the boiler can be easily removed without interfering with adjoining tubes. The removal of a deposit from the inner surface of the tubes is effected either by introducing the scraper, at the lower end through the hand hole, or at the upper end from the steam drum. The smallest steam drum used on this boiler is forty-two inches in diameter, giving ample space for men to operate when cleaning tubes. The chamber at the lower end is also sufficiently roomy for the cleaning. The hand holes in the distributing drums are covered and protected in the same manner as those of the manifold, the same fittings being used in both cases.

Another of the important features of this boiler is that it can be shipped as an almost complete unit. Each boiler is shipped in three sections, the sections consisting of steam drum, tubes, manifold and distributing drum. These are assembled and tested at the works, only requiring the connecting of the same at the place of erection to form the completed boiler. What will be at once apparent with a survey of the combine is the simplicity of form the boiler assumes when finished. All sections are connected by expanded tubes or nipples, not a single bolt or threaded connection being employed. This boiler is built in units ranging from 50 to 600 horse-power and is capable of carrying a working pressure up to 200 pounds per square inch. They are built by Mr. Moyes not only for power plants but also for office and other large buildings.

New Grease Cup.

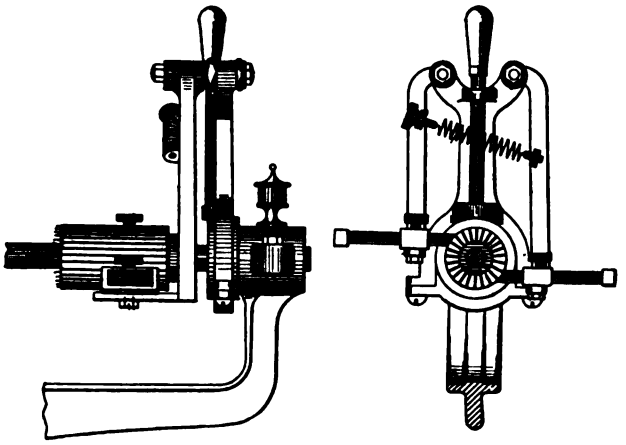


We illustrate herewith a new grease cup, which has recently been placed on the market by the Penberthy Injector Co., of Detroit, Mich., manufacturers of the famous "Penberthy" automatic injector. The name of this company is sufficient guarantee as to the quality of any new article which they may put on the market, but the grease cup in question has also many points of superiority over anything of its kind now in use.

First and foremost the body is a glass cylinder surrounded and protected by an outer brass shell with openings on four sides through which the user can tell at a glance the amount of grease or dope in the cup, and know when to re-fill it, so that the journal where it is used never need be dry, unless through carelessness. The plunger by which the grease is forced out from the bottom of the cup is made of a heavy rubber washer, protected on both sides by a brass disc, the whole being attached to the bottom of the stem in such a manner that the stem revolves without turning the washer or discs, and at the same time no grease can pass up through the center of the washer. The cover never needs to be removed from the cup, as the body of the cup is screwed on to the shank and is removed from the shank to be re-filled, therefore there is no chance for any of the parts to be lost or mislaid when the cup is being filled. This cup has met with a very rapid sale. Circular and price list of this cup will be sent on application to the above company.

Thomson Brush Holder.

One of the most important parts of every dynamo and motor is the brushes and holders, for upon them depends in a measure, at least, the efficiency of the machine. If contact is poor, brush holders of high resistance and not capable of adjustment, good results cannot be expected.

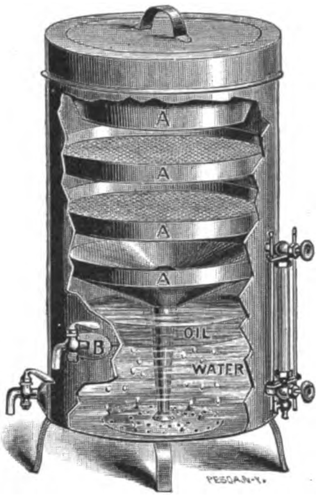


THOMSON BRUSH HOLDER.

As an improvement over the usual type of brush holder whose spindles are placed diametrically opposite each other, with brushes placed in tangential position, the holders shown in the accompanying cuts, taken from the Electrical Engineer, have been designed by Prof. Elihu Thomson. This holder provides a uniform position for the brushes throughout their life and do not have to be shifted as the brushes wear down, as is the case with the ordinary holder. The pressure of the brushes against the commutator is adjusted.

By a study of the cut it will be noticed that the brushes are given an end bearing on the commutator. They are carried in clamps mounted on swinging supports in such a manner that as the brushes or commutator wear down so that the brush clamps stand nearer or farther away from the center of the shaft, the contact will be equally good. By a special arrangement the brushes and brush clamps are always maintained parallel to the surface of the cylinder. This is effected by several parallel links connecting the brush clamp and its supports which always holds the brushes parallel to the same plane. The general features of the holder are shown in the accompanying cuts.

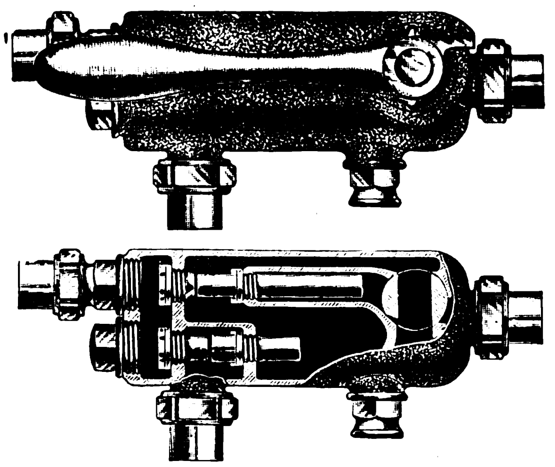
Robertson's Waste Oil Filter.



A simple, effective and low-priced device for reclaiming waste oil. In many establishments the drippings from the engines, pumps, and other bearings is thrown away, which, in the course of a year, represents many dollars. With this filter, the manufacturers, Hine & Robertson Company, Cortlandt St., New York, claim a saving of all this waste oil and ability to cleanse and purify it so thoroughly that it can be used over again and again; some of those using the device, claim a saving of fully two-thirds, which, in a plant of any considerable size, would soon return the cost, and after that show a very handsome dividend. The construction is exceedingly simple; the oil poured in at the top passes through three movable traps, each provided with suitable filtering cloths, and then down through the funnel to perforated receiver at the bottom, which breaks it up into small globules, and in passing upward through the water is washed of any remaining impurities and discoloration. It is made of heavily galvanized iron, handsomely japanned and striped; it is an ornament suitable for any engine room. All parts are separate, making it an easy matter to clean.

The Brownley Injector.

In the accompanying cuts is illustrated a new injector known as the Brownley valveless. It is manufactured by Edward F. Keating of 189 Cherry street, New York, and some very strong claims are made for it. The injector is a double-tube machine, and is very simple in construction.



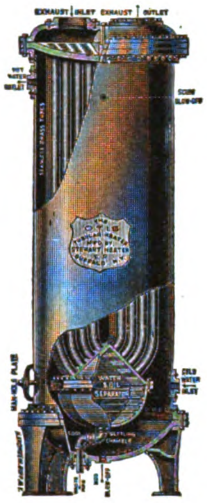
FIGS. 1 AND 2.—THE BROWNLEY INJECTOR.

An ordinary mechanic can take it entirely apart and put it together again in five minutes. To start the injector, steam is given, when water will immediately appear at the overflow. The lever on the side of the machine is then turned at right angles to its position when starting, and the water is shut off from the overflow and fed into the boiler. An inspection of the lower accompanying cut will make this clear.

It is claimed that this injector will start at 15 pounds pressure and work up as high as 350 and down as low as six pounds, without breaking and without requiring any regulation whatever.

There are no valves to regrind, the flow of water being controlled by the plug cock shown in the engraving. In a test made by the general foreman of the Manhattan Railway Company, the Brownley injector is said to have fed about 33 per cent more water in a given time than a machine of a well-known make, of the same rating. The Brownley locomotive injector is slightly changed in form so as to make the fittings interchangeable with other types and simplify the substitution of these machines for other makes.

The Otis Double System Water Heater.



The Otis double system water heater is manufactured by the Stewart Heater Company, of 120 to 130 Norfolk Ave., Buffalo, N. Y. This heater has two separate sections or sets of seamless brass tubes, attached at the upper ends into one tube sheet, this tube sheet having the proper dividing partitions, to allow using either the exhaust steam from an engine, or steam pump, or live steam direct from the boiler, or in fact, either or both can be used at the same time, without in any way interfering with each other.

The lower ends are attached to the water catchers, so-called, as they separate and carry off the water of condensation. These water catchers are entirely separate from, and act independently of each other, thus making two separate systems. The tubes are rolled into the tube sheet and water catchers as in a boiler. Each water catcher has a drip pipe, as shown in the cut. The water catcher on the exhaust steam section receives the water of condensation, and the oil that is carried over from the steam cylinder with the exhaust steam, which passes off through drip pipe to sewer, thus not only acting as a water catcher, but also as an oil extractor or eliminator.

The drip from the live steam water catcher can be connected to a trap, and the water of condensation returned to boiler, or by placing the bottom of the heater above the water line of the boiler, the water will flow by gravity into the boiler. This heater is adapted for places where hot water is required, and where the exhaust steam that can be utilized for heating purposes is small.

The Fyfe Automatic Releasing Motor Starting Box.

The rules of inspectors and underwriters require protecting devices in every circuit. The device herewith illustrated combines in one the several appliances demanded in every motor circuit. A description of its construction will best illustrate its operation. The frame of the rheostat is made up of two slabs of slate fastened together by bolts running through insulating bushings. It will thus be seen that the frame is fire proof and of high resistance. This frame is attached to the wall by means of iron legs, which are also insulated. The resistance coils are made up of fine wire wound upon iron cores. They are placed within this frame so that the iron cores project in the form of a half circle. Each of these iron cores is a terminal of one of the resistance coils insulated by a fire proof insulation of a special construction devised by the inventor of this rheostat. The wires are so fully covered by this material that further protection is unnecessary. The box is therefore open at the sides, permitting the free circulation of air, and thus perfect ventilation.

In the back of the box, projecting downward, is an arm carrying a curved strip of brass, upon the end of which are a number of iron discs. If by means of the handle shown this arm is moved back and forth these discs will be made to move over the ends of the iron cores. The movement will also open and close the double pole switch on the upper part of the frame. The two parts are so connected that the opening of the one opens the other and the closing closes the other. When it is desired to start the motor the arm is moved up in contact with the core of the first coil. The current passing through the coil and through the core and arm complete the motor circuit. The core is rendered a magnet, which holds the soft iron discs on the end of the arm in contact, holding it there until it is moved farther by the attendant. It will thus be seen that the arm can be moved up to any of the coils and remain where it is placed while the current is passing through the coils. If from any cause the circuit is broken the arm being released by the magnetism of the core will fall back of its own weight and the double pole switch will be opened at the same time.

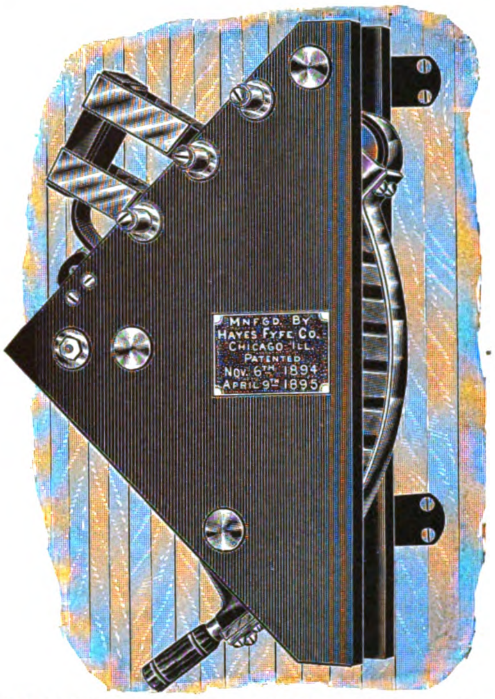


FIG. 1.—AUTOMATIC RELEASING RHEOSTAT WITH DOUBLE POLE SWITCH.

Another feature of the rheostat is that any amount of resistance from no resistance at all to the full resistance of the rheostat may be left in circuit with the motor, thus enabling it to be operated at a number of different speeds. The starting box is exceedingly simple in construction and very durable. The principles involved are new in this connection and are found most affective. It is manufactured and placed on the market by Hayes, Fyfe Co., 1006 Pontiac Bldg, Chicago.

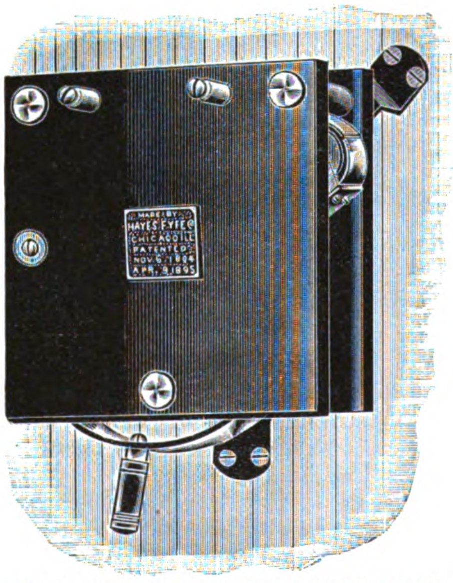


FIG. 2.—AUTOMATIC RELEASING RHEOSTAT WITHOUT SWITCH.

The Cotton States & International Exposition is to have electric launches on the lakes. The contract for the launches has been let to Gen. C. H. Bonney of New York.

M. & B. Telephones.

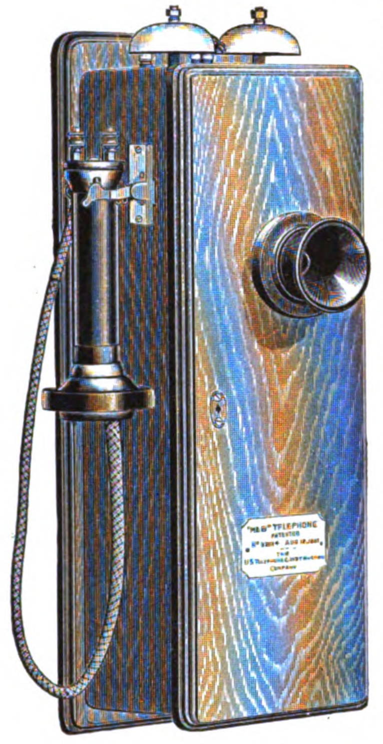


FIG. 1 M. & B. TELEPHONES.

In Fig. 1 is shown the style A of the M. & B. telephones as manufactured by the United States Telephone Construction Co., Bullitt Bldg. Philadelphia. It is designed for use on private lines, exchange work and general service, being well constructed and neatly finished. This, however, is but one of a variety of styles and sizes adapted for every service in which the telephone is used, manufactured by this company. The general outlines are similar to those of the instruments with which every one is familiar but it differs greatly in the details. The receiver is of the usual form and is connected by silk covered cords to the binding posts on the side of the magneto case.

The details of the transmitter which is generally considered the most important part of any telephone are shown in Fig. 2. The diaphragm is of India mica, a highly resonant material which gives great efficiency. Attached to the center of this diaphragm is a small aluminum cup holding a carbon or other suitable point. In front of the black rubber shell is shown the basket or runway of aluminum or other metal. The sphere shown in the cut may be of carbon or other material, eleven-sixteenths of an inch in diameter, which normally lays in the basket or runway, which is so constructed that no matter which side of the transmitter is up, the sphere rests on a plane which is always inclined toward the diaphragm. When these parts are assembled the point on the diaphragm comes about on a level with the center of the sphere which, owing to the angle of the side of the basket or runway, is kept against the point by gravity. The distance between the point on the diaphragm and the back of the basket is about three-quarters of an inch, which allows the sphere a maximum movement of a little under one-sixteenth of an inch.

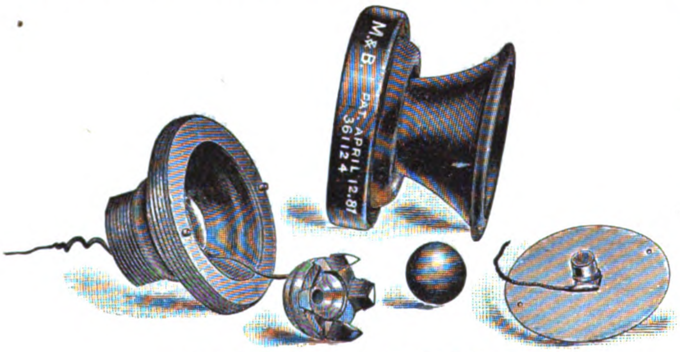


FIG. 2.—M. & B. TELEPHONES.

With every oscillation of the diaphragm a movement of this sphere takes place, which breaks the battery current, hence the name "Make and Break," and the well-known sign "M. & B."

The practical results claimed for this form of transmitter are: First, articulation, which is claimed to be better and more perfect. Every syllable, whether a shout or a whisper, is transmitted clearly and distinctly. There is no running together of words nor confusion of sound. Second, volume. While the volume of sound is great, yet there is no sputtering, snapping or frying sound. Third, long-distance transmission. Every M. & B. transmitter is a long-distance instrument. Fourth, simplicity of construction. There is nothing to get out of order; no adjustments to be made; no springs to give out; no "packing" and no plastic material to change in density. The United States Telephone Construction Company, which controls the M. & B. transmitter, invites competitive tests. These transmitters are covered by over ten construction patents, with others pending, being the broad method patent mentioned, which was issued April 12th.

Station Output Thomson Recording Watt-Meters.

To furnish a mathematically correct instrument to measure the full output of a station, and at the same time automatically to record, the result, the meter department of the General Electric Company has devised a new recording watt-meter known as the form "G." It is a development from the Thomson recording watt-meter, and although of course a much heavier instrument retains all the principles of the present well-known recording meters.

The form "G" recording meter is a series instrument and takes the whole current through its field. This allows the elimination of all errors which might arise were a high capacity shunt employed. As an instance of the value of this fact "G" meters constructed for 7,500 amperes work accurately and give excellent results even under the comparatively small current of 500 amperes.

The field of the meter consists of a one-half turn made of a solid copper forging of high conductivity, in the form of a wide winged yoke having the wings of sufficient width to permit of the insertion of the supporting studs. Within the "U" shaped part of this yoke revolves the armature actuating the dial mechanism. The shaft of the armature is, as in the other meters, prolonged and carries a copper disc which revolves between the jaws of three magnets set at the bottom of the meter.

The resistance in series with the armature is external to the meter. It is installed at the back of the switchboard and is there out of the way.

The meter is mounted directly on the switchboard, and is supported entirely by the heavy studs which pass through the material of the board and are secured by heavy nuts to the connections behind. The studs thus form the mechanical support and the electrical connections.

The cover of the instrument is of bevelled plate glass set in a burnished brass flange and rim fitting snugly against the board, and is provided with a felt packing to exclude dust. All the metal parts of the instrument are brightly polished, and impart to it a very handsome appearance.

As already mentioned these meters have been devised for the measurement and record of the station output. They are intended for connection with each machine or each feeder, or a single large meter may be connected for recording the total output of an entire power or lighting station.

They are manufactured in capacities of 2,500, 3,750, 5,000, 6,250 and 7,500 amperes, the first, third and last being considered the standard sizes and for pressures of 100 and 500 volts. The 100-volt instruments have been designed for use on the three wire systems, one meter being placed on each side of the line. The 500-volt meters are for use on railway systems or in stationary power plants.

In addition to the meters described above an arc station watt-meter for measuring the total output of an arc machine has also been devised. In this instrument the principles of the Thomson recording watt-meter have been retained, modifications being introduced to adapt it for use in connection with constant current circuits of high potential. The rheostat used with this arc station meter is a separate piece of apparatus to be installed in front or behind the board. It is designed for use under extremely high pressures, especial care being given to the insulation, and is mounted on a marble case.

The meters complete the line of general electric station recording instruments. For the alternating system, there are the primary meters in capacities ranging up to 600 amperes at 1,000 volts, or about 10,000 lamps. For the direct current systems for light, railway and power, the form "G" meters, or larger meters of standard form are employed, and for arc systems the arc station meter.

ELECTRICAL CATECHISM

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[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

[COMMENCED IN NO. 2, VOL. VI.]

74. *Is any practical use made of the action of points in scattering an electric charge?*

Many forms of lightning or spark arresters use points for this purpose. A common form used on telegraph and telephone lines is shown in Fig. 16. Some arresters have teeth on the ground plate also. If either wire is charged with static electricity, it will pass off at the points and go to the earth. Lightning rods are also provided with one or more sharp points.

75. *Do points collect or attract electricity as well as they scatter it?*

It is a common but erroneous idea that the points on a lightning rod or on an arrester or belt discharger actually collect the electricity from the clouds or from the belt. The explanation preferred by scientists is that the charge in the clouds or on the belt *induces* an opposite charge on the pointed metal as explained in answer to 70. Suppose the belt is charged positively; electricity is induced in the arrester, the positive part being repelled and going off to the earth; the negative part is attracted to the points and is there scattered as explained in 73. As the negative charge escapes from the points it unites with and neutralizes the positive charge on the surface of the belt or in the cloud. While therefore positive electricity flows away from the lightning or spark arrester, it is the induced positive electricity and not that originally in the cloud or on the belt.

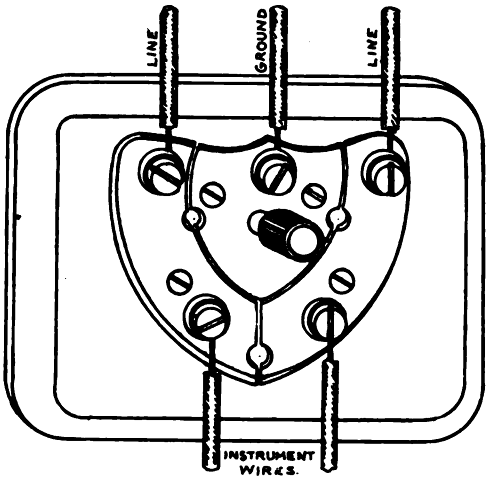


FIG. 16.

76. *What is the reason why a bundle of fine wires discharges a belt better than a single large wire?*

This is for the same reason as above. The bundle of fine wires presents many sharp points, each of which helps to neutralize the charge. For the same reason also, a piece of tin with a rough edge or with many sharp points is a good spark arrester or discharger.

77. *What is a Leyden jar?*

This can be understood best from an experiment. Partially fill a bottle with water, carefully dry the outside and place in the bottle a wire long enough to extend several inches above the top. Hold the bottle in the hand as in Fig. 17, so that the upper end of the wire is near a belt giving off electricity. After a few seconds touch the wire with the other hand, and you will get a hard shock. The shock will be harder if the wire is held near the belt longer, or if the bottle is larger. This was first discovered by a student in Leyden and is generally known as a Leyden (pronounced (*leden*) jar. The more common form is a glass jar coated on the inside and outside with tin foil up to within a few inches of the top. The glass is carefully kept dry and sometimes is covered with shellac or varnish to keep off moisture which would allow the electricity to creep along the surface from one coating to the other. Connection with the inner coating is made by means of a chain or light wire attached to a knob on the cork top.

78. *What is a condenser?*

A Leyden jar is one form of condenser. The glass jars are so expensive, bulky and easily broken, that another form is generally used when a large capacity is desired. The common form consists of a number of sheets of tin foil separated from each other by sheets of mica or paper soaked in oil or paraffine. The alternate sheets of tin foil are connected together as indicated in Fig. 18, and are then placed in a wooden box into which melted paraffine is poured so that the whole becomes solid.

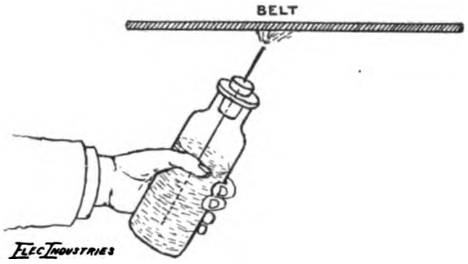


FIG. 17.

79. *Must the surfaces of a condenser be made of tin foil?*

No. Any conductor will do. Tin foil is used because it is cheap and easily handled.

80. *Are condensers common?*

Yes. Any two conductors which are near together and insulated from each other, act as a condenser. The iron frame of a dynamo or motor and the wire wound upon the fields and armature act as the two surfaces of a condenser, and one may sometimes get a severe shock by touching both at the same time. A long insulated wire buried in the earth or in the water forms a condenser on account of the surface of the wire and the surface of water or earth outside being so large and so close together. This is the principal reason why it is impossible to telephone across the ocean. Much of the "cross-talk" between different lines on the same poles is caused by the different wires acting as surfaces of condensers. A long lamp cord consisting of two wires or cables side by side has so much capacity that a strong magneto will ring through them, although the

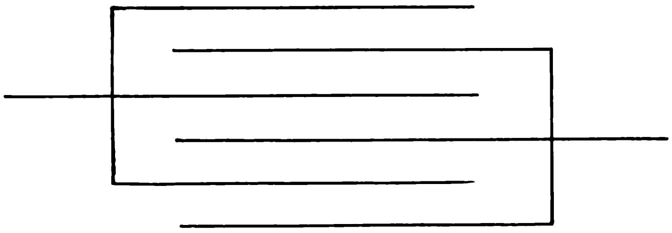


FIG. 18.

insulation resistance between them is millions of ohms. In the same way a strong magneto will ring when connected to the wire and to the sheath of a long lead covered cable, or between a long underground wire and the ground.

81. *What are condensers used for ?*

They are used in connection with high speed telegraph systems, and to some extent with telephones, alternating current motors, and some recent attempts to get light without heat. When properly connected and when of suitable capacity, condensers balance the self induction of long lines or of electro-magnets, so as to enable signals or other rapid variations in the strength or direction of currents to be sent faster with less interference. This action is rather complicated and its full explanation requires an extensive knowledge of mathematics and electricity.

Condensers are also used for making many accurate scientific measurements. Many experiments with static electricity are much more effective if condensers are used.

82. *Is there a simple and elementary explanation of the action of the condenser ?*

Its action is a result of the mutual attraction between positive and negative electricity. The condenser consists of two large conducting surfaces very close together. When the two surfaces are connected with a source of electricity such as a battery, dynamo or a static machine, positive charge collects on one plate and negative on the other. These charges attract one another so strongly that each surface will hold a large charge. The quantity of electricity held by the condenser depends upon the size of the surfaces, their nearness together, the nature of the insulating material between them and upon the difference of potential or electrical pressure between the terminals of the battery or other source of charge. If the two surfaces are connected by a conductor, the two charges run together and the positive and negative neutralize each other so that the condenser becomes discharged.

Electric Cars on the Nantasket Branch of the New York, New Haven and Hartford Ry.

On June 21st a test was made of an electric car on the Nantasket Branch of the New York, New Haven and Hartford R. R. The equipment of the road is nearly completed and the road will be regularly operated in a short time. The trial was successful in every respect and those who took part expressed themselves pleased with the operation of the line. The overhead trolley wire is used, suspended from poles placed between the tracks. The work has been most substantially done, the poles being placed in perfect alignment and erected in a substantial manner. They are set in wooden boxes five feet deep and three feet wide, the space around the pole being filled with cement concrete. The cars are equipped with four motors, Westinghouse air brakes and all the appliances of the steam cars used by this road. Upon the success of this branch of this railroad will depend the use of electricity on other short lines now operated by steam.

The creditors of the Electric Construction & Supply Co. have been notified by the receiver, Mr. Chauncey G. Parker, Newark, N. J., to present their claims against the above company within three months from May 16, 1895.

The Independent Telephone Manufacturers' Association of the United States held a convention at Pittsburgh last week. The convention was called to order by Mr. Jas. E. Keelyn, president of the Western Telephone Construction Co., who is president of the organization. Members of the association representing a capitalization of about $30,000,000, were present. Plans were made for the protection of the members of the association, etc.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

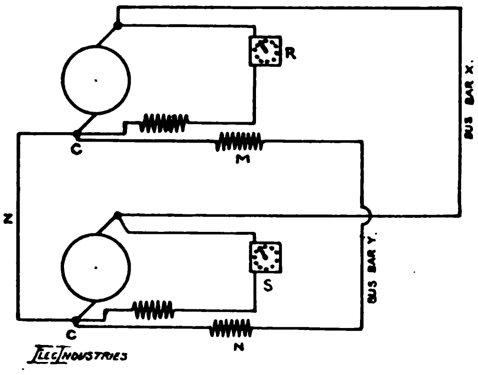
ALTERNATING CURRENTS ON SUBMARINE CABLES.

The blowing of a fuse carrying the working current can be attributed to the impedence offered the current by the reversal of magnetism in the iron armor. To overcome this difficulty I have recently suggested the use of hard drawn copper for armor, which in actual test has proven satisfactory. The life of good insulation is not materially affected by alternating rather than direct current. Chemically the alternating current should do the least harm from electrolytic effects.

New York. Ira W. Henry.

THE EQUALIZER FOR COMPOUND WOUND MACHINES.

In reply to the question asked by J. F., in regard to the use of the equalizer on two generators, I offer the following explanation, which I believe correct. The accompanying diagram illustrates the connections to the bus bars, the field windings, etc., for two compound wound machines. Thus are representing the two armatures; X.Y. the bus bars; M. N. the field windings and Z the equalizer wire. It will be noticed that both the series and shunt windings are connected in parallel when the equalizer wire Z connects the two brushes, CC. The field strength of the two machines will always be the same since the windings are practically on the same circuit. At the same speed the electromotive forces of the two machines will be the same and they will carry equal loads if of the same size. If the speed of one from any cause lags behind the other its electromotive force will be lower, and it will take less power and tend to speed up. The greater load on the other machine will tend to bring down the speed of that machine. The speeds of the two machines will thus be brought together again. The slightest variation in the speed of either machine will be automatically adjusted. If the equalizer wire was not used the slightest variation in the electromotive force of either machine would cause the machine with weakest current to be run as a motor, since the path of the current would be through the field coils and through the armature. The shunt coil would have so great a resistance proportionally that no current would pass through it. Machinery of any number of sizes, if of the same voltage can be connected to the same bus bars when this method is used. Eugene T. M.



MOTOR INSPECTION.

H. H. has the right idea about looking after his car and I can see a cause for several of his troubles. For instances, the fact that he found his boxes without grease was due to the grease having melted by the warm weather, the grease used in winter not being as heavy as that used in summer. That is the probable cause, although the boxes might not have been filled at the barn. The bearings will sometimes get hot in the winter with plenty of grease in the boxes on account of the box getting stopped up. This is easily remedied by putting a few drops of oil in after stirring it up. I once had a hot motor that puzzled a good many of us. The fields were fearfully hot and no one could guess the cause. We finally took the motor off and found that in some way the field coils of a smaller motor had been put on this motor instead of the right ones. The car had been repaired and had stood in the shop for several weeks, until every one had forgotten who repaired it. There is one thing I always watch carefully, and that is, the loose bolts or nuts. Loose bolts and nuts cause more damage than any other one thing about a motor. They fall off and get in where they don't belong. The result is usually most disastrious.

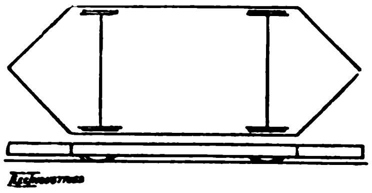
Buffalo. Tim. MacD.

SPARKING ARC MACHINE.

"Subscriber" who wants to know how to prevent his overloaded arc dynamo sparking so badly will find that if he takes off a part of the load his trouble will disappear. This is only a suggestion. Practice.

STREET CAR FENDERS.

I noticed in a recent number of Electrical Industries a communication from some one down east not very favorable to street car fenders. The average fender reminds me of a picture I saw some time ago in an illustrated paper of a man going skating on the ice. He was a large man, well cushioned naturally but in order to protect himself, should he fall, he had tied a large feather bed in front and another behind. His sides were unprotected. His efforts to skate were greatly impeded by his unwieldy safety cushions, while the other skaters glided along gracefully, enjoying the sport for which they came. Their skill in skating enabled them to make good speed, to avoid collisions and to keep from falling. The car with a fender is like the skater with the feather beds. It is unwieldy and does not fulfill its purpose as well as the car which depends on the skill of the motorman and the reliability of its brakes for avoiding accidents. The sides of the car are in nearly all cases where fenders are used, unprotected. I enclose a sketch of the guard used on nearly all Chicago cars. Its main object is to protect any person or thing from getting under the wheels. It is placed low down and close to the wheels. The forward end is brought to a point and objects are shoved to one side. I believe it is by far the safest device either for city or country.



Chicago. C. F.

Suspended Electric Railways.

Among the many systems of rapid transit proposed for our large cities is the electric suspended railway. The car is suspended from a truck running on the rails of an elevated structure instead of resting on the trucks. This method of construction is advocated by many European as well as American engineers. In fact, experimental roads have been built in both countries upon which the particular methods of the invention are being tried. Grants have been made for the construction of permanent lines between European cities, and the completion of the lines may be expected in the near future.

In Fig. 1 is shown a view of a suspended electric road proposed for Berlin. The car is suspended from two trucks which run on rails just within the two truss girders. Two of these tracks are suspended from the iron arches that span the street. The road is of a sufficient height so that the cars are above any vehicles or any thing that may be found in the street. The cars are reached from elevated platforms built at the side of the street. One of the features especially commending this form of railway is the lightness of the structure. It does not shade the street nor interfere with the trees along the walks. The cars are propelled by electric motors mounted on the trucks, and the current is obtained from trolley wires. The controller is placed in the forward end of the car, which will accommodate fifty passengers. The arrangement of brakes is said to be such that the car is easily stopped. The line is divided into blocks so that if any thing should happen to a section of the line, stopping a car, the next car would be deprived of power before reaching it.

In Fig. 2 is shown a section of a trial line erected near Deutz, just across the Rhine from Cologne. The cars are said to run very quietly and to pass curves easily. This system of elevated railway, which is known as the Langen system, is advocated on account of the low cost for construction, this item being the great objection to the ordinary elevated railway.

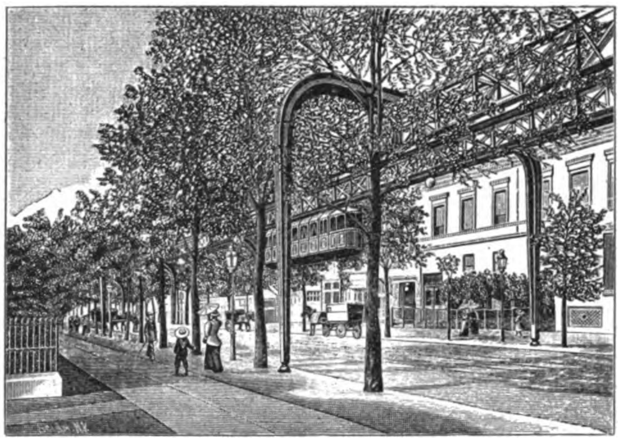


FIG. 1.—SUSPENDED ELECTRIC RAILWAYS.

A concession has been granted the promotors of this sysfor a line from Elberfeld to Bremen. The line when constructed will demonstrate the advantages or disadvantages of this method of rapid transit. While foreign inventors are working upon these problems American inventors are not idle. Railway systems of similar design and others quite different are being experimented with at different places. The designs are modified to suit the different conditions of city and country. One of the main ideas of all is to place the road bed where it will not be impeded by either street traffic or other lines of railway. The illustrations are taken from a recent number of the Scientific American.

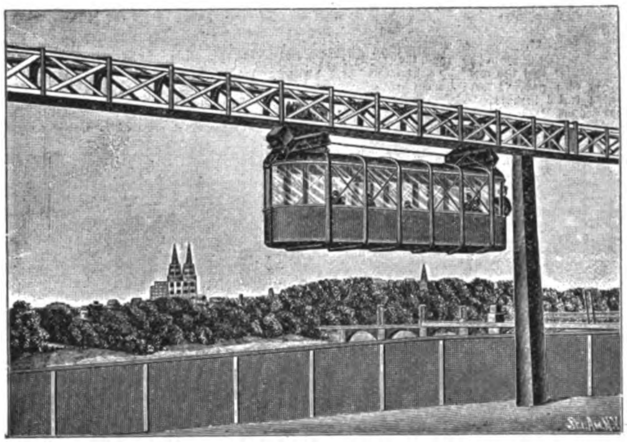


FIG. 2.—SUSPENDED ELECTRIC RAILWAYS.

The new passenger steamship North Land recently launched at Cleveland, Ohio, is lighted by 1,200 incandescent lights and is equipped with a search light of 100,000 candle power.

The new electric line between Munhall and Pittsburgh, made up of the Schenley Park & Highland Ry. and the Honestead & Highlands St. Ry., was opened last month. The line will be greatly patronized by outing parties and others seeking the country, as along the route there are many attractive resorts and excellent places for picnic parties, etc.

PERSONAL.

Mr. Jas. I. Ayer of St. Louis was in Chicago last month.

Mr. H. T. Paste sailed for Europe on June 15 for a combined business and pleasure trip.

Mr. H. H. Brooks, of the American Circular Loom Co., Boston, was in Chicago for a few days last month.

Mr. George W. Hommeld has resigned his position as general superintendent of Milwaukee St. Ry. Co.

Mr. G. A. McKinlock, of the Central Electric Co., was in New York on a business trip of several days last month.

Mr. W. H. MacKay now represents the Columbian Incandescent Lamp Co. of St. Louis in New York, with offices at 1103 Havemeyer building.

Arnold Spiller has resigned the superintendency of the Buckeye Electric Co. of Cleveland, O. Mr. Spiller goes to Europe to spend several months.

W. H. McKinlock, president of the Metropolitan Electric Co., Chicago, recently returned from a fishing expedition, bringing with him some good results of the trip.

Mr. H. M. Littell, until the present time of the New Orleans Traction Co., succeeds Mr. Norton as president and general manager of the Atlantic Ave. Railroad Co. of Brooklyn.

Mr. H. H. Harrison has acquired an interest in the business of R. B. Corey, Havemeyer building, New York. Mr. Harrison is well known to the trade, having previously been connected with several prominent companies handling electrical goods.

Max A. Berg, secretary of the Wallace Electric Company, has resigned his position as an officer of that company to take effect July 1st. Mr. Berg will take a well-earned rest, and no doubt will become associated with the electrical industries again in the near future.

Mr. Frank W. Bunn, the genial western representative of the Southwark Foundry & Machine Co., with offices in The Rookery, Chicago, has been transferred to an important position in the east. His many Chicago friends regret his departure, although pleased to see his promotion.

Mr. Arthur D. Newton, general manager of the Eddy Electric Mfg. Co. of Windsor, Conn., was married to Miss Gertrude Hyde at Hartford, Conn., on June 12. The congratulations and good wishes of their many friends and acquaintances accompany them on their wedding trip.

B. J. Launiere, formerly secretary of the Grand Rapids Machinery & Electric Company, has recently been employed as traveling salesman by the Metropolitan Electric Company, 186-188 Fifth Ave., Chicago. Mr. Launiere is a man of remarkable ability, well liked by the trade, and is meeting with great success in the sale of electrical supplies.

Mr. Edward M. Hagar now represents the Southwark Foundry & Machine Co. of Philadelphia at Chicago. Mr. Hagar is a graduate of the Massachusetts Institute of Technology and also of Cornell when he received the degree M.M E. He has recently been connected with the Electrical Department of the North and West Chicago street railways.

Mr. Frank L. Perry, of the Western Electrician, was married at the First Presbyterian church, Chicago, on June 27, to Miss Lucretia Falkner. Mr. Perry has been connected for several years with the above publication, and his many friends and acquaintances among the electrical fraternity wish him every happiness and success in this his latest undertaking.

Obituary.

Henry Wakefield Frye, until recently an associate editor of the Electrical World, died on June 20th, near Folsom, New Mexico, of consumption. He had taken up his temporary residence in this section hoping to obtain relief from lung trouble resulting from an old attack of pneumonia, but as the results show, without avail. Mr. Frye was born in Belfast, Me., in 1868. He graduated from Colby University of Maine, and afterwards took a course in the department of Electricity at Johns Hopkins University. In 1892 he accepted a position on the above journal, where he displayed remarkable ability in his work as a journalist. His death will be greatly regretted by all who knew him.

NEW BOOKS.

The Financial School at Farmerville Reported by Cotton M. Barley. Issued by the Currency Publishing House, Chicago, 1895. 124 pages. Price, 25 cents.

The ideas of the author on the silver question are presented in a discussion which is supposed to take place at one of Coin's Financial Schools which was instituted at Farmerville, Ind. The ideas and arguments of Coin are answered in the supposed discussion. The story, however, is but poorly carried out, the author being too much engrossed in the presentation of his own ideas to make the characters fit the speeches or the speeches fit the characters. Still, there are some amusing features and the argument is not without merit.

Elementary Problems in Current Electricity for Technical Students. By James E. Boyd and Newton H. Brown, 1895, Columbus, Ohio, H. E. Brown & Sons. Cloth, flexible covers; 45 pages; price $.35.

It is a series of questions covering the elementary principles of electric current with an appendix, containing the answers, designed for the use of students. The problems have been selected with a view to illustrating the fundamental principles that form the basis of electrical engineering. Each chapter, into which the book is divided, is accompanied by references to standard works where the student can find full information about that subject. This method is certainly an excellent one for fixing in mind the various rules and formulæ. The subject of resistance is covered in the first four chapters. Single conductors, changes with temperature, resistance of compound conductors and Ohms law is the order in which it is arranged. Work and heating effects of currents, chemical effects, capacity, induction and magnetic effects is the arrangement of the remainder of the questions in chapters. The questions on any one subject are sufficiently numerous to fix the rule in mind. The book to advanced students will be found an excellent review.

The Telephone Systems of the Continent of Europe. By A. R. Bennett, 1895; London and New York. Longmans, Green & Co., cloth; 436 pages; 169 illustrations; price —

The author presents in the introduction many of the questions that have been discussed in England on the telephone systems in the present state and as under the contemplated government control. He points out the defects in the proposed system with a comparison of the systems on the continent as described in this volume. The different countries of the continent are taken in alphabetical order and the telephone system of each country is described. A brief history of the telephone in the country serves as an introduction, which is followed by a description of the system, the tariffs, prices paid the employes, etc., etc. In some countries the telephone and telegraph systems are so connected that a description of the latter is necessary. Considerable attention is given to the details of line work, and station instruments are mentioned usually only by name, as it is inferred that the reader is familiar with the standard makes of telephones, switchboards, etc. To persons interested in telephone service this book cannot fail to be interesting and instructive. It shows the telephone system throughout Europe, the workings of both private and government systems and the changes from one to the other. The figures given show also the cost of telephone service. To one interested in the subject of government monopolies the facts presented will be found of assistance. The details given of the construction work in the different cities are also valuable to telephone men.

The Horseless Age.

Times change and we change with them. The growth of the bicycle in popular favor has been wonderful, and even now the horse has been almost superseded by it. The student of history fifty years hence may perhaps read of the glorious "Charge of the Bicycle Brigade;" of another King Richard reeling from the bloody field of Tewkesbury and offering to exchange England for a Monarch bicycle; of another Sheridan scorching down the Winchester pike grasping a pair of handle bars on his swift Monarch; of another Paul Revere, not pausing a moment to tighten his saddle girth as he nervously watches for the signal light in the old North Church tower which was to ring up the curtain of the Revolution, but standing by his Monarch examining it carefully to see that all nuts were tight and tires hard for a run that was destined to become memorable.

The bicycle has come to stay and the reign of the horse is over, while the supremacy of even the cable, electric and steam cars may yet be overthrown. The "Golden Age," the "Electric

Age" or any other remarkably progressive period in the world's history pales before the wonderful growth and popularity of the bicycle.

An Important Purchase by the Siemens & Halske Electric Co. of America.

Immediately following the destruction by fire of the greater portion of the works of the Siemens & Halske Electric Co. of America, last summer the large manufacturing plant of the Grant Locomotive Works was leased from the receivers. Even at that early day the purchase of the works was contemplated. This has now been consummated and the works will soon pass under the ownership of the Siemen's & Halske company. This plant is located on a plat of 80 acres, thirty of which are covered by buildings especially constructed and equipped for the production of heavy machinery, and situated in the town of Cicero, a few miles west of the business center of Chicago. When the company took possession after the execution of the lease, the special tools necessary in the production of electrical machines, were added to the equipment It is said that the shops are unexcelled for the production of heavy machinery. Their location on the lines of the Wisconsin Central and the Chicago & Northern Pacific railroads and connections to all railroads centering at Chicago gives them unsurpassed shipping facilities.

TRADE PUBLICATIONS.

Our English contemporary, "Electrical Plant and Electrical Industry" comes out in a new dress and a change in its name for June. It has discarded the ugly cut that formerly decorated its front page and its title is now printed in bold type "Electrical Plant and Electrical Industries", prominence being given to the last two words of its name. The color of the cover has been changed to a terra cotta, quite similar to that of this journal. The many attempts of both domestic and foreign publications to imitate the prominent and well-known features of ELECTRICAL INDUSTRIES is certainly the highest testimony to the superiority of this now extensively known American electrical journal. We congratulate our English friends on their good taste.

A recent publication of the C. W. Hunt Company, of 45 Broadway, New York, is entitled "Industrial Railways." The various questions which come up regarding railways for handling material about manufacturing establishments are presented and then satisfactorily answered in the description and illustrations of the railways manufactured by the above company for industrial works. The profitableness of investments of this kind are considered and their general plan and construction described. Almost every detail of the systems built for different purposes is illustrated either by engravings of roads in operation or by detailed drawings. Electric and steam locomotives are both shown for use in connection with these railways. The pamphlet is well gotten up, the cuts are clear and it is neatly bound in dark paper.

The English edition of the "Electric Tramways on the Overhead Trolley System," by the Allgemeine Elektricitats-Gesellschaft, Berlin, has been recently published. It is gotten up in the same elegant style as the German edition. It will be welcomed by all English-speaking electrical men, as it shows the methods of construction, apparatus employed and many interesting facts regarding the electric tramways as installed by the above company in Europe. The number of roads illustrated is a considerable part of those on the continent. The figures, tables and facts of general interest to railway men contained therein will be found useful. The book is handsomely gotten up. The engravings are remarkably clear; the text is carefully written; the paper and general arrangement most excellent.

As a supplement to the general elevator catalogue the Sulzer-Vogt Machine Co., of Louisville, Ky., has issued a pamphlet describing and illustrating its electric elevators for passenger and freight service. The elevator machinery, cages, etc., are illustrated by numerous cuts. The important features of the machinery are described in the text, which also calls attention to the excellence of the electrically operated elevator. The hoisting machinery, controlling and safety devices, cost of installation, operation, etc., are treated at some length. Persons interested in elevators or contemplated purchasers will find in this catalogue much of interest to them. It is sent upon application. The number of elevators operated by electricity has grown rapidly within the past few years, and the above company seem to be supplying their proportion of the equipments.

The General Electric Company has recently issued a pamphlet bulletin, No. 4,044, which contains arc lighting statistics of more than 500 cities and towns distributed throughout the United States using electric street lights. The matter is arranged in tabulated form and opposite each name is given the population of the city or town, the length of contract, number of lamps, their candle power, the lighting schedule, number of hours per year, cost of coal, contract price per year for city lighting, cost per lamp hour, and candle power per hour for one cent. The information is especially valuable for comparison and covers a large territory, every state in the Union being included. The price of coal, hours of lighting together with the contract price for public lighting gives additional data, although local conditions, distance of station from center of the city, nature of the system of distribution, whether overhead or underground, etc., regulate largely the cost of arc lighting. The pamphlet will, however, be generally appreciated by central stations, who will find the information of assistance as a guide in making contracts, since it shows the current prices.

Economy Guarantees of Engines issued by the Westinghouse Machine Company, is a little pamphlet calling attention to the importance of guarantees covering the economy of engines. This has not been overlooked by the above company, and it explains therein the attention given to it. The facilities at the works for making tests enables the true facts to be determined for the various types of engines, and these are published in tables and charts in circulars covering this feature of the Westinghouse engine. These tests are conclusive as to the economy of the engines, as they show the manufacturers just what the engines can do, and the guarantees are made with a full knowledge of the facts and not from hastily made tests or only estimated efficiencies. Tests will be made at the shops for purchasers of any engine, before it is shipped, when desired. These facts, and many more, are explained in this recent pamphlet.

The saving in use of electricity over horse or cable power on street railroads is fully illustrated by a comparison of operating expenses on the Philadelphia Traction system. It cost the company, when horses and cables were the motive powers of the system, no less than 18⅛ cents per car per mile. In May the cost was about 10 cents per car per mile, and three kinds of power were then in use--horse, cable and electricity, the latter of course, predominating. Within the next thirty days it is expected the cost will be reduced to less than 9 cents per car per mile, as electricity will, in that time, have supplanted the cable on Market street and horses on the Richmond and Christian & Ellsworth streets branches. The latter will not be made a separate trolley line, but will be divided among existing lines in such manner as will make it more convenient for the public and more profitable for the company. The Baring street division is now operated as an electric road, and its earnings are said to have doubled. The increased traffic is simply a recovery of the business diverted to the Hestington road, when the latter was opened.—Phil. Stockholder.

Three-Phase Installations.

An interesting power transmission plant is in course of installation at Bayonne, N. J., where the three-phase system of the General Electric Company will be employed to operate the machinery of the Tide Water Oil Company. This company is one of the Standard Oil Company's interests and is engaged in exporting the refined products of petroleum. The nature of the process is such that spark proof apparatus is an imperative necessity and multi-phase apparatus was selected as the machinery which would meet the peculiar conditions.

The generators will be a 550 volts three-phase General Electric machine having eight poles and a capacity of 75 kilowatts. The several induction motors will be of five, ten and fifteen horse power. Some of these are spark proof, and have a permanent resistance in the armature circuit. A special interest attaches to these, as they will be employed in places where there exists an ever present danger of explosion from gases, which a spark could readily ignite. They will be used to operate pumps, elevators and other machinery. The switches will be of special construction, their blades immersed in oil.

The generator also supplies current for about 525 lights scattered throughout the different parts of the works. Regulation of the lighting circuits will be effected by special revolving regulators of novel design.

The Oakland Gas and Electric Company, of Oakland, Cal., will also use a three-phase transmission plant for general power work. Current to a number of induction motors ranging from one to fifteen horse-power will be supplied from a 75 kilowatt three-phase machine and there will be extensive lighting in connection with the plant. The generators current at 2,000 volts will be reduced at two centres of distribution to the necessary potential and the secondary net work will cover a territory of 1,200 feet in every direction from both centres. From these points pressure wires will be run back to the power house, and the voltage will be there controlled by potential regulators.

A plan somewhat similar will be followed by the Fall River Electric Company, of Fall River, Mass., but instead of three-phase, monocyclic apparatus will be used. Two 75 K. W. generators will be used and the out-put will be used for lighting purposes, during the dark hours, supplying current during the day for general power work. The motors will be of the General Electric induction type ranging from one to ten horse-power and will be wound for 110 volts, to which pressure the current generated at 2,000 volts will be reduced.

BUSINESS NOTES.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., is running its factory thirteen hours a day to keep up with contracts on hand. The extensive line of electrical apparatus manufactured by this company are well known and the busy factory speaks well for the business for this season.

MESSRS. F. H. CORNELL & CO., 469 W. 14th St., New York, have been very busy supplying the demand for the Hercules boiler oil injector. This machine is constructed for feeding kerosene oil by the drop to feed water boilers. There are, the manufacturers claim, over 6,500 boilers equipped with these appliances. They are also being exported to foreign countries. Price lists are furnished on application and the injector is sent on trial.

Huyett & Smith Mfg. Co., Detroit, Mich., reports a heavy increase in the demand for ventilating fans of which a specialty is made. The fans are made in numerous styles and sizes and for being operated either by electric or other power. Mr. S. B. Corby is western manager, with office at 31 So. Canal St., Chicago.

The Elwell-Parker Electric Co. of America, with general offices and factory at Cleveland, O., has recently opened a western office at 1528 Marquette Bld., Chicago. Mr. F. G Tallman, previously connected with several large manufacturing companies, and with extensive experience as manager, will have charge of the office.

Mr. Romaine Callender, Decker Bldg., New York has on exhibition in the Decker Bldg., Union Sq., New York, his new automatic telephone exchange system which was recently described and illustrated in this journal. Visitors will be welcome until July 21st, the system remaining on exhibition up to that time.

The United States Telephone Co., and Eastern Electrical Mfg. Co., have issued invitations for an exhibition of a complete non-infringing telephone system comprised of the Gould-Smith metallic circuit central office and toll line switch boards of the Eastern Electrical Mfg. Co., and the M. & B. standard exchange telephone in rooms 450 and 451 Bullitt Bldg. Philadelphia, continuing to July 6th.

Mr. Frank DeRonde, 254 Front St., New York, has, in connection with his brother, Mr. A. DeRonde, taken the general selling agency for the United States and Canada of the "ship" cored carbons manufactured by Schiff, Jordan & Co , Vienna, Austria. These carbons are said to be of an excellent grade, insuring a most satisfactory light. These gentlemen are well-known and their success in this line is almost certain.

Chas. E. Gregory, president of the Chas. E. Gregory Co., Chicago, has just returned from a two weeks' trip in the east where he went to buy stock. Mr. Gregory succeeded in purchasing several car loads of dynamos, motors, lamps, search lights resistances of all kinds, etc., to the value of $6,000 or $7,000. For awhile, at least, his company will, he says, have some most tempting bargains to dispose of.

The Central Electric Co., 173-175 Adams St.,Chicago, reports business for the past month one of the heaviest in the history of the house. The immense stock of all standard goods carried enables prompt shipments to be made under usual circumstances. Sometimes, however, the factories have been unable to keep up with orders. The experience of the heads of the different departments enables the trade to be anticipated and orders kept in ahead of the demand.

The Weston Electrical Instrument Co. of Newark, N. J., has found its old quarters insufficient to accommodate the manufacturing plant and arrangements have recently been made for more extensive accommodations at Waverly, N J. A plot of 48 acres of land has been purchased for a manufacturing plant and cottages for employes of the works The increased facilities thus obtained will permit some of the improvements and additions to the present extensive line of electrical instruments contemplated, to be made. The Weston instruments have an established reputation wherever electrical plants are in operation and their sale has rapidly increased.

The Metropolitan Electric Co., 186 and 188 Fifth Ave., Chicago, finds that its trade has multiplied this year more than three times the amount at the same period last year. The success of this company has been unprecedented and the future seems even more bright than ever. Some of the best known specialties on the market, among which are P. & B goods, N. I. R. rubber wire, Solar arc lamps, Metropolitan incandescent lamps, etc., are handled by this company. The first shipment of Ayer arc lamp windlasses, which were described in the last number of this journal, has been received and disposed of. Other shipments are on the way. A large trade has been had in the various kinds of electric fans handled by them, which are intended for all places and every position.

The Electric Appliance Co., 242 Madison St., Chicago, has just closed exclusive arrangements for handling the Russell automatic switch. This switch enables the lights to be turned on and off by the pressure of one of two buttons, which may be placed at any convenient point. The company is offering special inducements in the line of flexible switch cords for electric railways and in their Paranite flexible cable, of which a large stock is carried in the west. A large business is being done in the Jaeger miniature lamps, for which the Appliance company has recently taken the general western agency. The lamps, however, are but one of the large list of electrical goods of this make, all of which are handled by this company. A special catalogue of these goods may be had on application.

The Chicago Rawhide Manufacturing Co., Chicago, reports that its trade is improving in a very satisfactory manner. At present the company is particularly busy in making shipments for its foreign trade, some very large orders for its goods having lately been received from Europe. The following interesting item is from a recent issue of the "Engineer & Iron Trade Advertiser" of Glasgow: "LARGE DRIVING BELT.—What is believed to be the largest driving belt imported from America was on view a few days ago at the premises, 116 Queen Victoria St., London. It was made by the Chicago Rawhide Mfg. Co., is 120 ft. in length by 3 ft. 1 and ¾ in. in width, and weighs nearly 7 cwt. Although a double belt, it is nearly as liable as a single one. It may be mentioned that a similar belt made of tanned (instead of rawhide) would weigh at least 1,300 pounds."

The Ball Engine Co., Erie, Pa., has received a large number of orders recently that are keeping the works busy. Among these plants in which Ball engines are to be used are the following: The new electric light plant for the City of Wells, Minn., installed by Claussen & Bonwell of St. Paul; the Suburban Traction Co., Orange, N. J., a 150 horse-power Ball engine; the Herald Building's, Baltimore, electric light plant, consisting of Ball engine, direct connected to General Electric dynamo; the National Bank of Commerce, Pittsburg, now being built will have an electric light plant; the Edison Light & Power Co., La Crosse, Wis , has purchased a 225 horse-power Ball engine, which will be direct connected to two General Electric dynamos, one on each side of the engine; the new Tradesmen's Bank Buildings of Pittsburg, Pa., large electric light plant consisting of three Ball engines, direct connected to Westinghouse dynamos; the Mount Washington Light & Power Co , Hollins, Md.; the new Juvenile Female Offenders' Home at Geneva, Ill.; and the Catholic University, Washington, D. C., has lately put in an electric light plant, operated by Ball engines.

The General Electric Co. is making the first application of the three phase long distance system to street railway work at Lowell, Mass., where a plant is in course of construction for the Lowell and Suburban Street Railway Company. Its special features will render it one of the most interesting three phase installations ever effected. In the first place, the generators will deliver both alternating and continuous current, and when not in use for transmission work will be run in parallel with the railway generators now in the station. They will be wound for delivery of low voltage current at the alternating side, and this current raised to 5,000 volts will be carried to two substations one nine miles and the other fourteen miles distant from the generating station. The substations will each be provided with suitable step-down transformers of the General Electric air-blast type, as well as two rotary converters. These machines are constructed to maintain at the commutator brushes a voltage of 5,000 volts at no load, and 550 volts full load. Another transformer substation for 400 incandescent lamps will be installed six miles from the generators. The success of this plant will go far towards solving the problem of the operation of railways over long distances, taking the current from the one power station. When it is completed we shall present a full description to our readers.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED Position as Electrician and Superintendent of an electric light company, or Superintendent of some construction company. 12 years' experience in general electric construction and management of electric plants having had charge of some of the most important installations in the country. Can furnish the best of testimonials as to ability and attention to duty. Address 756, care Electrical Industries, Chicago.

WANTED: Position as manager or superintendent of central station. Experienced and in every way qualified. Address, Geo. W. Kendrick, Front Royal, Va.

AGENT WANTED for the U. S. A. for the sale of first-class German electric carbons, on commission; apply to FERDINAND HOTZ, 1318 Masonic Temple, Chicago, stating references.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

The Chicago Opera House is again being crowded by large audicences which are drawn by that popular extravaganza, Ali Baba. It appears this season with many novel features, which make it more attractive than ever. The gorgeous stage settings and magnificent lighting effects are by no means the minor attractions of the piece. In the marvelous transformation scene incandescent lamps not only furnish the light but are also worked into the scenery. The play will continue for some time. Many of the parts will be changed at intervals, making it always attractive to the audience.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. August, 1895. NEW YORK. No. 8.

Power Transmission and Lighting Plant in the Brooks Locomotive Works, Dunkirk, New York.

How best to transmit power is a question with which the engineer and manufacturer have had to deal for many years, and until the advent of electrical transmission opinions differed widely as to the merits of the shaft, the belt, the steam, water and compressed air systems, and while, in certain instances, one of these old systems showed itself better than another, they were all far short of the engineer's idea of perfection. Practically there was little to choose between them, and when electricity as a means of transmission appeared, and the theories of its advocates were demonstrated to be sound, there no longer existed a question as to the best. Electricity soon outstripped all other systems in the extent of its application, and by reason of its many advantages stands today as the most perfect and widely used system known to the engineering world.

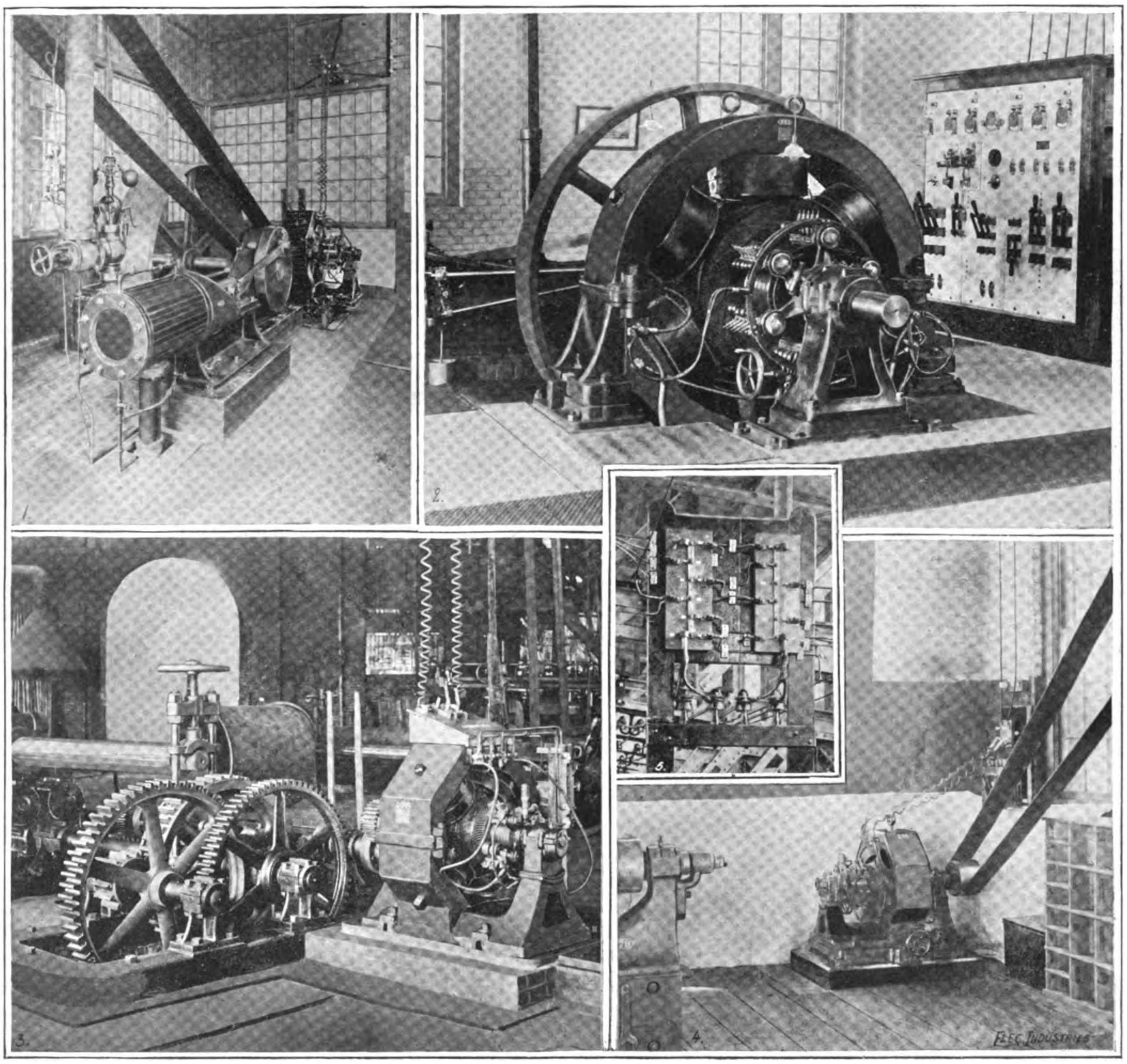


Fig. 1.—30 horse power motor driving fan blowers. Fig. 2.—130 K. W. generator and switchboard in power plant. Fig. 3.—Motor driving rolls. Fig. 4.—Motor in machine shop. Fig. 5.—One of the centers of distribution.

FIGS. 1, 2, 3, 4 AND 5.—POWER TRANSMISSION AND LIGHTING PLANT IN THE BROOKS LOCOMOTIVE WORKS, DUNKIRK, NEW YORK.

Large manufacturing establishments, conducted as they usually are by men whose first study is economy of operation, have not been slow in perceiving the advantage to be secured by the introduction of electrical transmission and lighting. Changes are being made as rapidly as possible, and adoption of electricity is universal.

The Brooks Locomotive Works at Dunkirk, New York, are among the first in this line of business to adopt electric transmission, and the extent to which they have introduced it shows the interprise and sound business judgment of the management.

The accompanying illustrations show the principal features of the installation. Fig. 2 is a view of the large generator in the power-house; it is directly connected to a Buckeye engine of 200 horse power and running at a speed of 175 revolutions per minute gives an output of 130 kilowatts at a pressure of 225 volts.

The generator is designed with special reference to the duty it is to perform. It is over-compound wound to maintain constant voltage at distributing points and take care of speed variations of the engine under different loads. Changes in the output from zero up can be made instantly, and to any amount without calling for any attention or adjustment.

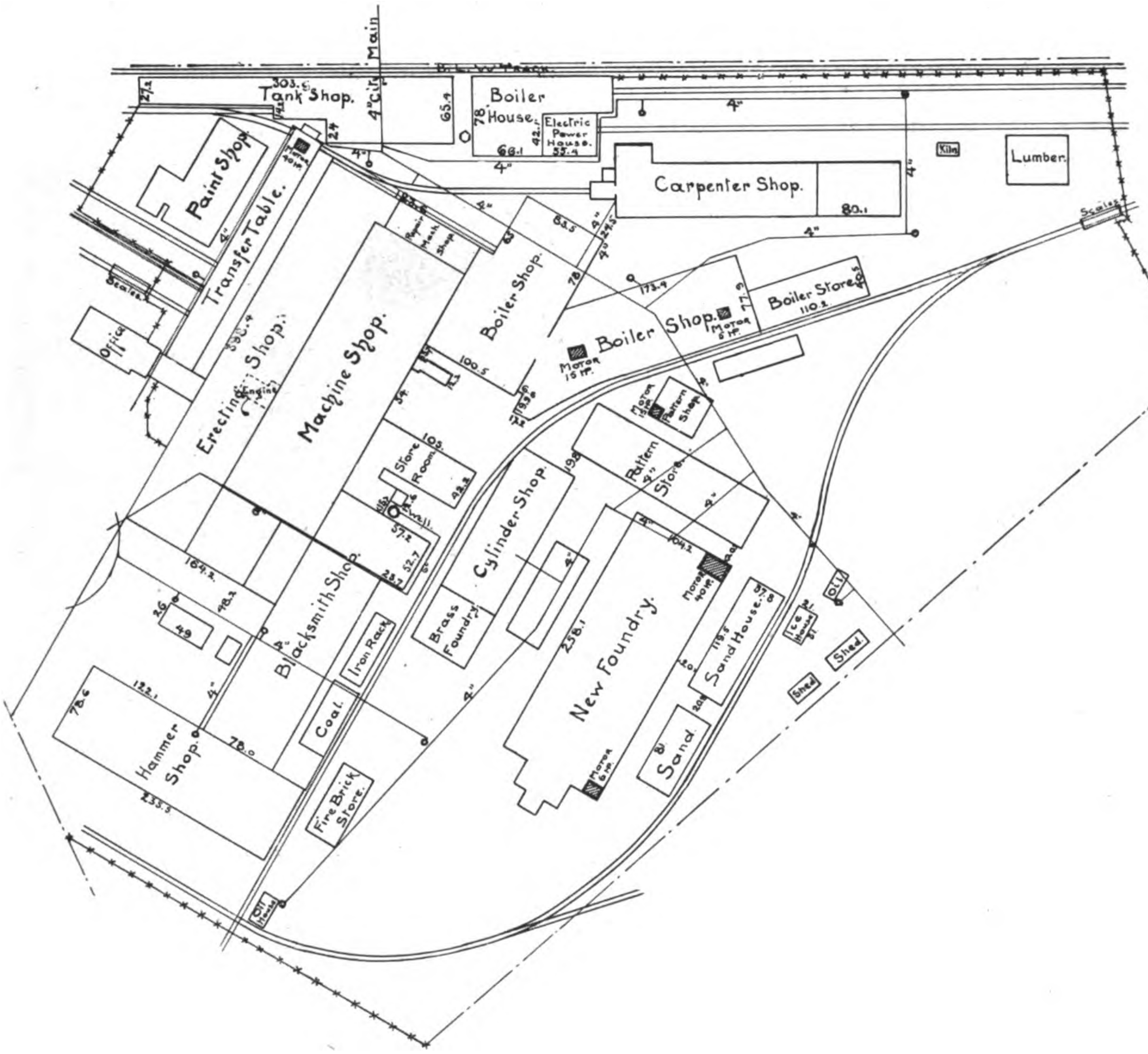


FIG. 6.—POWER TRANSMISSION AND LIGHTING PLANT IN THE BROOKS LOCOMOTIVE WORKS—PLAN OF WORKS, SHOWING LOCATION OF MOTORS

The armature is of the iron-clad type, the conductors being thoroughly insulated and protected from abrasion or mechanical injury of any kind, ventilating openings are provided in the core, allowing air currents to circulate freely and thus prevent accumulation of heat. By a new system of end connectors the armature conductors are so connected as to secure low resistance and perfect ventilation.

The commutator is of hard bronze insulated throughout with best mica, and the collecting brushes of carbon are of such proportion and design that they permit the most extreme change of load to be made without requiring adjustment and without sparking.

A cast iron ring with wrought iron cores and pole pieces six in number from the field magnet frame which is supported on sole plates attached to the main engine foundation.

The armature is mounted directly upon the shaft of the engine, and a heavy outboard bearing, which also serves as a support for the brushes and connections, is provided at the outer end of the shaft. This outboard bearing rests upon a sole plate which is adjustable to facilitate lining up and taking up wear.

Under full load this generator has a commercial efficiency of 93 per cent, and after a run of 10 hours the heating of any part does not exceed 60 degrees Fah. above surrounding air.

In addition to this generator, the power station is equipped with another of 70 kilowatts' capacity to be used at times when the load is light or in multiple with the large one to take care of heavy loads.

The main switch board, shown in Fig 2, is of white marble mounted on a substantial iron frame work and so arranged as to give ready access to all parts, both front and rear. All the switches are massive, of neat design, and of a rich copper color, contrasting well with the polished surface of the marble. Feeder switches are made to divide the system into two groups, if desired, and to give control of the different sections of the system of distribution. A volt meter, with a special switch, enables the attendant to ascertain the pressure at different points and make tests of circuit insulation. The usual complement of main switches, rheostats, etc., are provided on the board, and, indeed, nothing seems to have been omitted that could in any way add to the perfection of the outfit.

Fig. 5 shows one of the distribution centers. These are nearly all placed in position upon the roof girders, but arrangements are provided for giving easy access to them at all times. One result of this plan is that no space is occupied on the walls of buildings, and the lengths of wire required are shorter.

Fig. 3 shows the method of connecting a motor to a set of boiler plate rolls; this motor is reversible, and its speed is under full control at all times. This service is particularly trying to the motor and controlling apparatus, for the reason that the motor is subjected to sudden reversals under load in making short or irregular bends in certain parts of boiler plates, but notwithstanding this fact the motor, which is of 30-horse power, does the work in a manner most satisfactory in every respect. This motor and, in fact, all motors throughout the installation are of the multipolar iron clad type for both field and armature, and are slow speed.

Fig. 1 is an object lesson in engineering. It shows a view of the engine and engine room which formerly supplied power to the fan blowers for the foundry. It will be observed that off in a little corner of the room is placed the 40-horse-power motor which has supplanted the engine, and that it has not been necessary to enlarge the room.

Fig. 6 is a plan of the Brooks Locomotive Works showing the size and arrangement of the different buildings, the location of motors, etc.

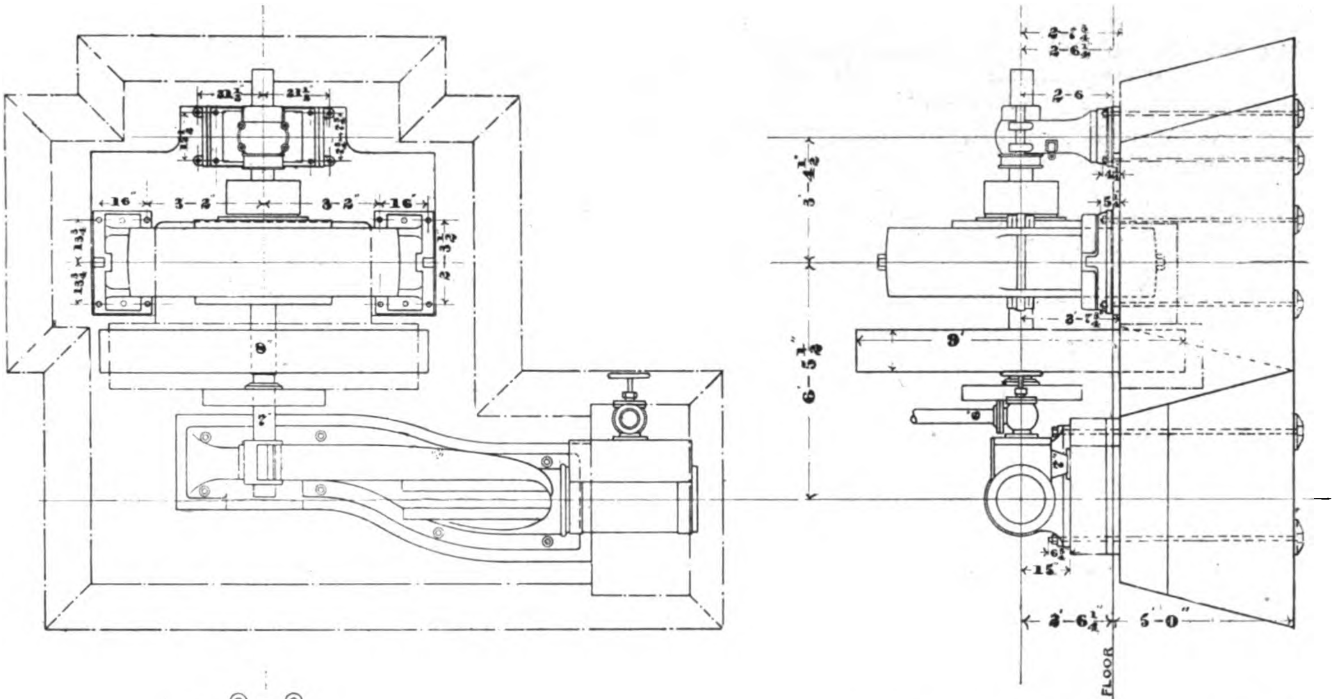
The transfer table is equipped with a 40-horse power reversible motor provided with mechanism for controlling and regulating the speed, and it is capable of moving their heaviest engines as slowly as may be desired.

The hydraulic elevator in the foundry is operated by a Gould's triplex pump directly connected to a 6-horse power motor, automatic devices being provided for stopping the elevator at the different landings.

Although the Brooks Locomotive Works covers an area of twenty acres with facilities for turning out locomotives at the rate of one a day, no difficulty whatever has been experienced in supplying power at any point desired, the perfect flexibility and adaptability of the system being most practically demonstrated by this installation.

Before the work of replacing the old steam apparatus with electrical was begun careful estimates were made of the power required in the different parts, and it was gratifying to find that in every case the electrically indicated power tallied closely with the estimates.

The system of lighting comprises both arc and incandescent, the arc lamps being operated four in series on constant potential of 220 volts, while the incandescent lamps are run two in series. Special porcelain covered cut out blocks are used equipped with long fuses and rendering impossible the formation of an arc between the feeders. The system of wiring is mostly overhead and is so proportioned as to avoid unnecessary loss of energy at any point.



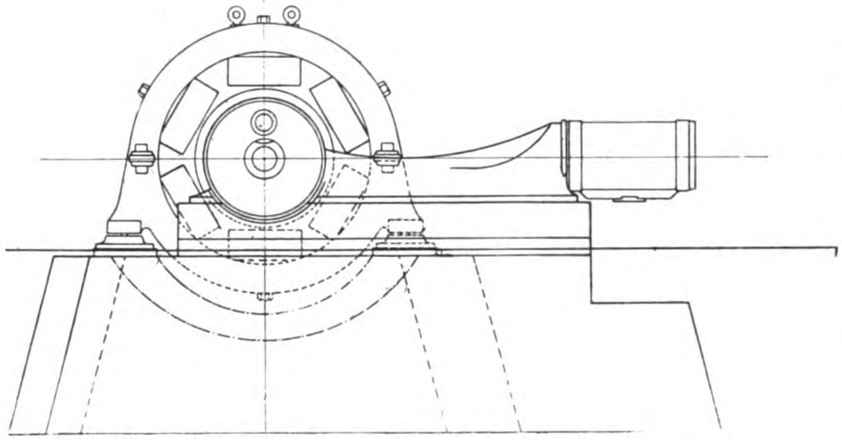


FIG. 7.—POWER TRANSMISSION AND LIGHTING PLANT IN THE BROOKS LOCOMOTIVE WORKS—DETAIL OF ENGINE AND DYNAMO.

The Western Electric Company, of Chicago, by whom this plant was installed, have spared neither time nor expense to render this installation perfect in every detail, and that it is so has been proven by several months of active and satisfactory service.

The engines in the power plant were built by the Buckeye Engine Co., of Salem, Ohio. The 70 kilowatt generator is direct connected to a 12 by 16 simple engine and the 130 kilowatt generator is direct connected to a 15½ by 24 engine, each of the well-known Buckeye type. The engravings do not show the engine, but its qualities for the operation of electrical generators are well known. The different types of Buckeye engines have been described at different times in the colums of ELECTRICAL INDUSTRIES. The detail drawings show the engine settings and the mounting of the generator armature on the engine shaft.

The Cotton States and International Exposition.

The electricity building at the exposition is already receiving exhibits preparatory to the opening in September. The wiring for the electric lights, both arc and incandescent, was recently commenced and will be pushed forward rapidly. The electric fountain is in process of construction and when completed will possess, it is said, many features not previously attempted in electric fountains. The details of the fountain were carefully worked out before the construction work commenced and it is expected that it will be almost perfect throughout. It will be one of the interesting sights of the exposition.

Exhibitors of electrical apparatus are already preparing for the opening. Among those who are preparing exhibits are the Bell Telephone Co. which will operate a complete central station on the grounds with instruments located at different points. The exhibit will be very handsomely arranged and will be a credit to the company. The General Electric Co., which was one of the first companies to apply for space, will make a creditable display. The Brush Electric Co. and the Ft. Wayne Electric Corporation have applied for large spaces upon which to place exhibits. The Westinghouse Electric & Manufacturing Co. has secured a large central space upon which will be arranged an attractive exhibit. Assignments have also been made to the Clark Electrical Specialty Co. and Post-Glover Electric Co. both of which will make a display of electrical specialties and supplies. The Western Electric Co. is also at work upon an original design for an exhibit. It is thus assured that the exhibit of electrical apparatus will be one of the prominent features of the exposition.

The Belt as Applied to Electrical Apparatus.

BY A. W. FOSTER.

The belt is being lost sight of in the rapid development of direct connected apparatus for electric lighting and electric street railways, but it will continue to hold a universal place whether constructed of leather, cotton and leather or rubber. For the benefit of the purchasers of belts and in order to reduce interruptions to a minimum and keep the belt in good working order, some knowledge of the material entering into their construction is necessary. Leather is essentially the skins of animals, consisting chiefly of gelation chemically altered by vegetable principle called tannin, or tannic acid. One of the most important of the various forms of these acids is gallotannic acid ($C_{14} H_{10} O_9$). It invariably occurs as a light, inodorous, spongy, colorless or faintly yellow mass freely soluble in water. Gallotannic acid occurs in large quantity in the gall nut, which contains, according to Pelouze, as much as forty per cent of this acid. The manner of obtaining it is from powdered gall-nuts, by extraction with commercial ether in the percolation or displacement apparatus. So many processes are required for the different hides to undergo, and numerous additions applied to this branch of economic botany, it would be impossible to include them all in this article. In a word, the application of gallotannic acid impregnates the hides and arrests that tendency to decompose which is characteristic of soft animal substances. This is the whole theory of tanning, or converting skins of animal into leather.

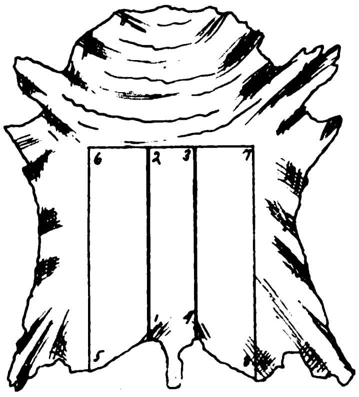


FIG. 1.—HIDE READY TO CUT.

Fig. 1 illustrates the grade of leather that should enter into the construction of belting for electrical purposes; 1-4-3-2 represents the centre usually put into wide belts and usually taken from that portion marked 1-5-6-2 and 4-8-7-3. The lower grades are made from the outside portions. Belting for dynamos and electric motors should be made of the very best stock and expressly for the purpose; pure oak-tanned, short lapped leather, fastened only with cement, made endless at the factory, is the best. If the workmanship is first-class the belt will be attractive in finish, of uniform quality and thickness, thoroughly stretched, and will run straight with a minimum of taking up. The main belt should always be a three ply, or heavy double, the former if the belt is large; better work can be obtained, as they run with little flap and few vibrations, thereby prolonging their life. The smoothness of running and staying power should depend upon the quality and firmness of leather used, the best results being obtained when not filled or buffed.

Waterproofing belts: For waterproofing, special preparations and dressings are used by most manufacturers, entirely free from chemical action, as no acid, oil or tallow is used in the waterproofing of their belting, consequently there is nothing to gum, or crystalize and work out. When waterproofed in this manner they are increased in durability, and can be run under a greater tension than "dry" belts. The slip is diminished by giving more adhesion to the pulley, and are ten per cent stronger.

Slipping of belts: The slipping of belts is a source of constant trouble as well as waste of energy, and not only tends to heat the dynamo, but causes fluctuations in the lights. The belt may be too short, too narrow, or overloaded. The pulley on the dynamo also may be so small that the belt cannot get sufficient contact with its surface. Greasy or oily belts are troublesome. Castor oil is frequently used with success to keep the belt soft and pliable, but should not be applied over two or three times a year. As a result of the excessive application of this oil to a new sixteen-inch double leather belt the stretching amounted to twenty-six inches in two weeks, two temporary uprights being used to keep the belt on the pulley. Imagine the efficiency! Prolong the life of your belt by keeping it clean and free from accumulations of dust. Frequently use a good dressing. The fibers of the leather when saturated with oil are ultimately destroyed and stretched beyond the elastic limit, and the belt, no matter how well made, is rendered useless.

FIG. 2.—SECTION DYNAMO BELT.

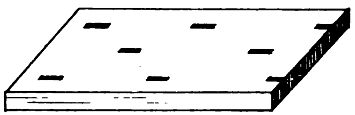


FIG. 3.—SLOTTED DYNAMO BELT.

Tension: The belt should have proper tension, as great tension shortens its life. They should never be tightened more than enough to prevent an excess of slippage of over two per cent. A large belt requires more care in this respect than a small one. We recall an incident which occurred a short time since in a street railway power house. The engineer, when starting up, stood by the throttle giving his whole attention to the engine, and neglected to notice that the belt had been slackened and that his cotton leather belt had swayed off the pulley into the dynamo bearing until the engine, which was a two hundred and fifty horse-power Corliss, failed to cut off. Needless to say the belt was rendered useless.

Link belting: The advantages claimed for link belting over other forms are, great adhesive power, small tension on belt and pulley bearings, lateral and longitudinal flexibility. The belting being made of links, is especially shaped to the form of the pulley; the links are united by rods, and fastened in parallel strips. They are adapted especially for damp places, being the only leather belt that is absolutely waterproof, as there are no cemented joints to give way by dampness. Avoid using grease, oil or rosin; the glazed surface upon the running side should be removed by sand paper.

Slotted belts deserve particular attention from the purchasers of belting. The slots effectually and permanently prevent air cushioning, as the slots afford means of escape for the air without large loss of strength to the belt.

Rubber belts: Rubber belts should be used ordinarily in places exposed to the weather; they do not absorb moisture and stretch and decay. They consist of combination of rubber and duck; the latter being the sole strength of the belt should be made of staple cotton. To prevent slipping, the running surface should be slightly moistened with a composition of equal parts of boiled linseed oil, litherage and black lead, with enough Japan to dry it. Grease and animal oil should not be used, as they dissolve the rubber.

A writer to a contemporary suggests a means of repairing the insulation of commutators. He says he has found that litharge mixed to the consistency of thick cream with glycerine and applied to the cracks of the commutator, restores the insulation. After being applied it should be allowed to dry 10 or 12 hours and then filed down level with the top of the commutator segments.

The Alternating Current; Its Generation and Distribution.—VIII.

BY PROF. GEO. D. SHEPARDSON.

In the last section it was stated that the only practical way of regulating the electromotive force of an alternator is by varying the strength of the magnetic field in which the armature rotates. The different methods of doing this depend upon the well established law that the number of lines of force, or the strength of the magnetic field, equals the magnetizing force divided by the magnetic reluctance or resistance. This law is closely analogous with the more familiar "Ohms' law," that the current equals the electromotive force divided by the resistance. The electromotive force of the alternator may be regulated, then, by varying either the magnetizing force or the reluctance of the magnetic circuit or both. The more common methods vary the magnetizing force.

The field of an alternator usually consists of a ring-shaped yoke with a number of pairs of inwardly projecting polepieces with coils which magnetize them so that adjacent poles are of opposite polarity, as suggested in Fig. 20. The magnetizing current is sometimes obtained from a separate set of coils wound upon the alternator armature and having a separate commutator and brushes. Such a machine is sometimes called a "self-excited" alternator. Usually the magnetizing current is derived from a smaller dynamo known as an "exciter." The exciter may be either an entirely separate machine as shown in Fig. 18 of the Electrical Industries for May, or it may be part of the alternator itself, the alternator armature and the exciter armature being fastened to the same shaft, as in the machine illustrated in Fig. 19. The exciter is always a continuous current machine and generally is shunt wound, that is, having its own field magnet excited by a small current shunted from the main current. The main current, that magnetizes the fields of the alternator, may be regulated either by varying the resistance of the alternator field circuit or by means of the main rheostat, or by varying the electromotive force of the exciter. The exciter is regulated by means of the rheostat in series with its shunt field, the electromotive force being higher when the resistance is cut out of the rheostat. In some cases the alternator is regulated entirely by varying the electromotive force of the exciter, but it is more common to use the two rheostats so as to obtain a closer adjustment. Several alternators are sometimes magnetized from the same exciter, in which case the regulation of the different machines is effected by means of the main rheostats. The common method of connecting the exciter and alternator is indicated in Fig. 20.

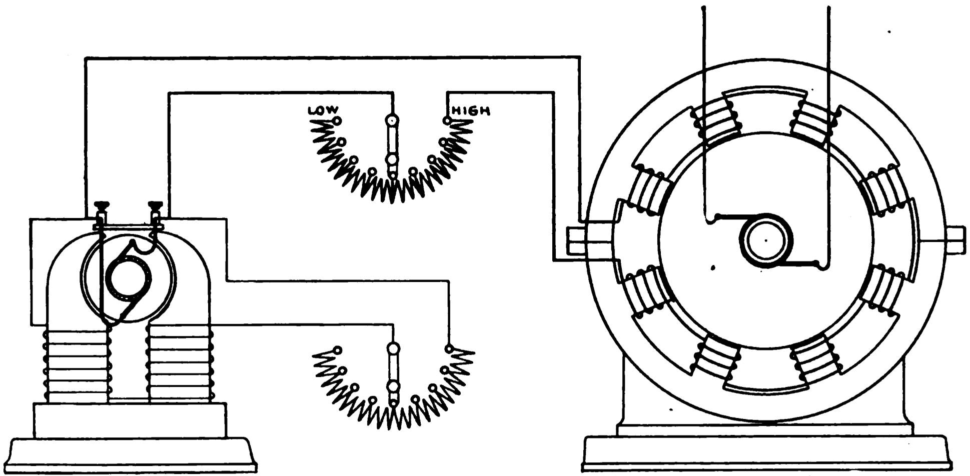


FIG. 20.

Alternators sometimes have a double set of field coils, one set of which carries current from the exciter and furnishes the principal magnetizing force. The second set of coils is for the purpose of automatic regulation and furnishes more or less additional magnetizing force according to the load or total current taken from the alternator. This corresponds to the compound field winding of continuous current constant potential dynamos. The current in the extra set of coils is part of the main current from the alternator. Only a part of the main current is sent through the field coils because the total current would be too strong and would magnetize the fields too strongly; also there would be no way of adjusting the alternator so as to make the automatic regulation more or less exact. For these reasons, a resistance known as a "shunt" is connected into the main circuit. The terminals of the shunt are also connected to a commutator through which connection is made with the regulating coils on the field magnets of the alternator. The commutator is mounted upon the same shaft with the alternator armature and has as many sections as there are poles in the field. Alternate sections are connected together as indicated by the dotted and solid lines in Fig. 21, so as to make two sets of segments. Brushes are arranged to press against the commutator in such positions that the connections between the commutator and brushes are reversed at the same instant that the alternating current changes direction. By this means the current through the brushes and through the regulating field coils is "rectified," or "commutated" from an alternating current to one which is always in the same direction but which pulsates from zero to a maximum value for every alternation of the main current. The commutation is necessary because the principal exciting current is continuous, that is, uni-directional, and so the auxiliary or regulating current must also be uni-directional. By such an arrangement of shunt, commutator and auxiliary field coils, a certain part of the main alternating current is rectified and used to strengthen the magnetic field so as to compensate or balance any tendency for the electromotive force of the alternator to become lower as the load becomes greater. Such an alternator is sometimes designated as "composite wound." By properly adjusting the resistance of the "shunt," the alternator may be made to regulate automatically for constant electromotive force, or it may be over compounded to compensate for the drop on the lines and so to keep a constant electromotive force at the center of distribution where the current is used. The brushes of a composite alternator are adjustable and must be shifted more or less to prevent sparking when the load changes. This is because the current in the armature distorts the field to some extent, varying with the design of the machine. This fact of the reaction of the armature upon the field is a source of some trouble to the operator because be must keep the brushes at the non-sparking point. If the brushes become shifted too far in either direction, vicious sparking occurs, the current in the regulating coils does not have full effect and the electromotive force becomes less. If the brushes are shifted the full width of a commutator segment, the sparking will stop, but the current will be reversed and the auxiliary coils oppose the principal coils and weaken the field rather than strengthen it.

Armature reaction is utilized in a few alternators to accomplish the very regulation which, in most machines, it opposes. The method by which this is accomplished is somewhat complicated, and all do not agree about the correct explanation. An approximate explanation will be given as suggestive. The regulation by armature reaction may be considered as caused by varying the reluctance of the magnetic circuit, or by varying the effective magnetizing force, or by varying the proportion of the total magnetic field that traverses the armature and is used in generating electromotive force, or by various combinations of these effects.

The magnetizing effect of the current in the armature of an alternator depends not only upon the relative strength of the currents in the armature and in the field coils, but also upon the relative positions of these currents. With continuous and unvarying currents, the current is always and at all times strictly equal to the electromotive force divided by the resistance. But with pulsating or alternating currents, the electromotive force and the current are not always "in phase"; there may be considerable current at an instant when the electromotive force is zero, and the current may be zero when the electromotive force has an appreciable value. This will occur when there is considerable capacity or self-induction in the circuit. Ordinarily the circuits used for lighting or power transmission do not possess enough capacity to introduce any considerable disturbance, so that capacity may be neglected. In telephone and telegraph circuits, capacity has considerable effect. The circuits used for electric lighting and power transmission by alternating currents do, however, possess considerable self-induction, which causes the waves of current to "lag behind" or come later than the waves of electromotive force.

In lighting by incandescent lamps, it is customary to carry the energy from the alternator to the point of distribution by means of comparatively small currents at high pressures or electromotive forces, 1,000 and 2,000 volts being the pressures commonly used in America. At the distributing point, or where the energy is to be used, it is changed from a small current at high pressure to a larger current at the low pressure of 50 or 100 volts. The reasons for this practice are: that high pressures are undesirable for indoor use; that incandescent lamps are not adapted for ordinary use on high-pressure circuits; that large currents at low pressures can be satisfactorily distributed over limited areas only. It is necessary, therefore, to transmit the energy at high pressure and to have some device for transforming the energy from high pressure to low pressure. The arrangement for accomplishing this is the very simple and efficient device known as a "converter" or "transformer." As was well explained in an article in the July number of ELECTRICAL INDUSTRIES, the transformer consists essentially of a laminated iron core surrounding two coils of wire, one of which usually has ten or twenty times as many convolutions as the other. If one coil carries an alternating current, it magnetizes and demagnetizes the core rapidly, thereby inducing alternating electromotive forces in the other coil. The ratio of the electromotive forces in the two coils is very closely equal to the ratio between the number of turns or convolutions in the coils. Conversely, the ratio between the currents is inversely proportional to the ratio of the convolutions. In fact, the transformer may be considered as a dynamo in which the coils are all stationary but in which the magnetism revolves or reverses.

Since the transformers are efficient and self-regulating, so that the current taken by the "primary" coil is almost exactly proportional to that delivered by the "secondary" coil, it is the common practice to leave the primary coils of the transformers connected to the "primary" or high pressure mains all the time. The ohmic resistance of an alternating current primary circuit for incandescent lighting is therefore practically constant.

Since practically all of the current from the alternator passes through the primary coils of transformers, the primary circuit has a considerable amount of "self-induction," which has a sort of fly-wheel action tending to retard and diminish rapid changes in the strength and direction of the current. Experience and theory show that the amount of retardation or "lag" of an alternating current depends upon the relative values of the ohmic resistance and the self-induction of the circuit. As shown above, the ohmic resistance of the primaries of incandescent lighting circuits is practically constant. But the self-induction varies with the current, being greatest when the current is least. This seems inconsistent at first, but it is explained by the fact that the self-induction of each transformer primary coil diminishes in order to allow more current to pass when the secondary current increases.

Arc lamps are operated from ordinary alternating circuits by the use of transformers connected across the primary mains. With the Westinghouse arc light alternator the primary circuits of all the transformers are connected in series. In either case, the ohmic resistance of the primary circuit is constant and the self-induction varies. Sometimes arc lamps are connected directly in the primary circuit of arc light alternators, in which case, both the resistance and self-induction vary. This last case is not of very common occurrence and need not be considered here.

It is seen, then, that in most cases of lighting circuits, the resistance of the primary circuit is constant and the self-induction varies with the load. In the case of circuits with transformers in parallel, the current in the alternator armature and outside line therefore lags behind the electromotive force a variable amount, lagging less as the load increases. The diminution of the lag causes the electromotive force to be more effective, thus tending to balance the increased losses due to resistance of the armature and to weakening the field magnetism.

Again, the electromotive force is highest when the center of each coil is midway between a pair of poles. In such a position the current in the armature coil has the least effect in weakening the field. Therefore the armature reaction in weakening the field is least if the current is in phase with the electromotive force, and if the current is at its maximum value at the instant when the axis of the armature coil is midway between the poles. It may be seen, then, that by properly designing the alternator the armature reaction may be made to balance the losses in the machine and even those on the line. Similar reasoning applied to circuits with primaries of transformers connected in series will show that by proper design the machine will give constant current with the electromotive force varying as may be necessary.

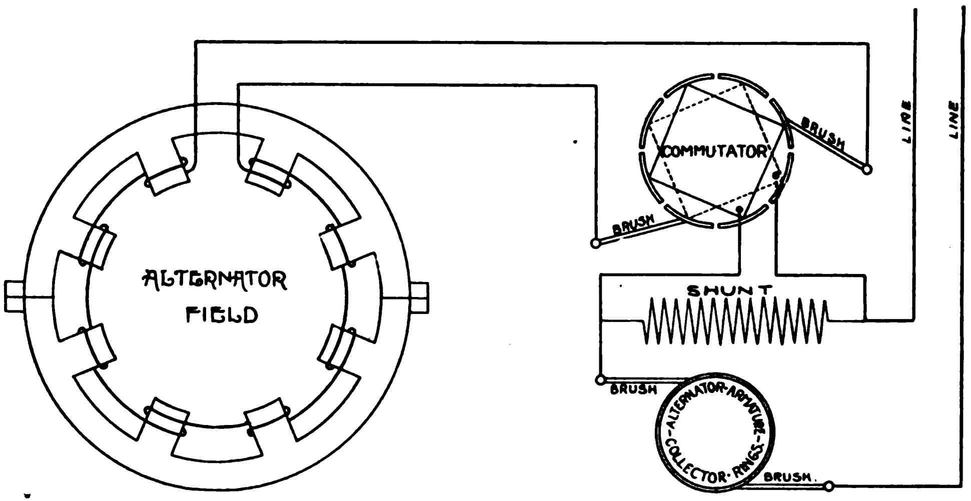


FIG. 21.

While the method of regulation by armature reaction is somewhat complicated (and the above explanatory remarks do not fully cover the case), several manufacturers have succeeded in producing machines that regulate very closely by armature reaction. The operation of such machines is beautifully simple, easy and satisfactory.

Contracts for Street Lighting in Chicago.

Contracts were recently made with different companies for street lighting by the city of Chicago as follows: People's Light and Power Company, 128 lights at $105 per light; People's Electric Light and Motor Power Company, 132 lights at $105 per light; Hyde Park Electric Light and Power Company sixty lights at $84 per light; Mutual Electric Light and Power Company, forty-three lights at $82 per light; Calumet Gas Company, gas lamps at $20 per lamp including maintenance.

An organization of electric supply dealers and contractors of Buffalo has been effected. L. P. Jones is president.

The Niagara Falls Power Plant.

No enterprise of modern times has attracted greater attention from the engineers of the world and the public in general than the work which was undertaken some years ago by the Niagara Falls Power Company for the utilization of a portion of the power of the Niagara Falls. This company, which is made up of some of the best known capitalists in America, by extensive purchases of real estate and public concessions acquired such rights as enabled it to construct the great engineering works which have recently reached sufficiently near completion as to show by tests the excellence of the plans which were devised by the most eminent engineers of the world. No previous power plant had required such extensive plans nor such large power units. Experience and data were, therefore, lacking as regards the size of the equipment, and the engineers were obliged to devise entirely original plans.

With these great falls every American is in a measure at least familiar. If he has not viewed them from the many points to which the visitor has access, he cannot have failed to have read of them, the source of their supply and the course of the water to the sea. About 275,000 cubic feet of water pass over the falls each second, falling from the crest of the falls 165 feet. The total horse power of these falls has been estimated at not less than seven million. The amount of water used, therefore, in the works of the Niagara Falls Power Company will have no appreciable effect on the amount that passes over the falls.

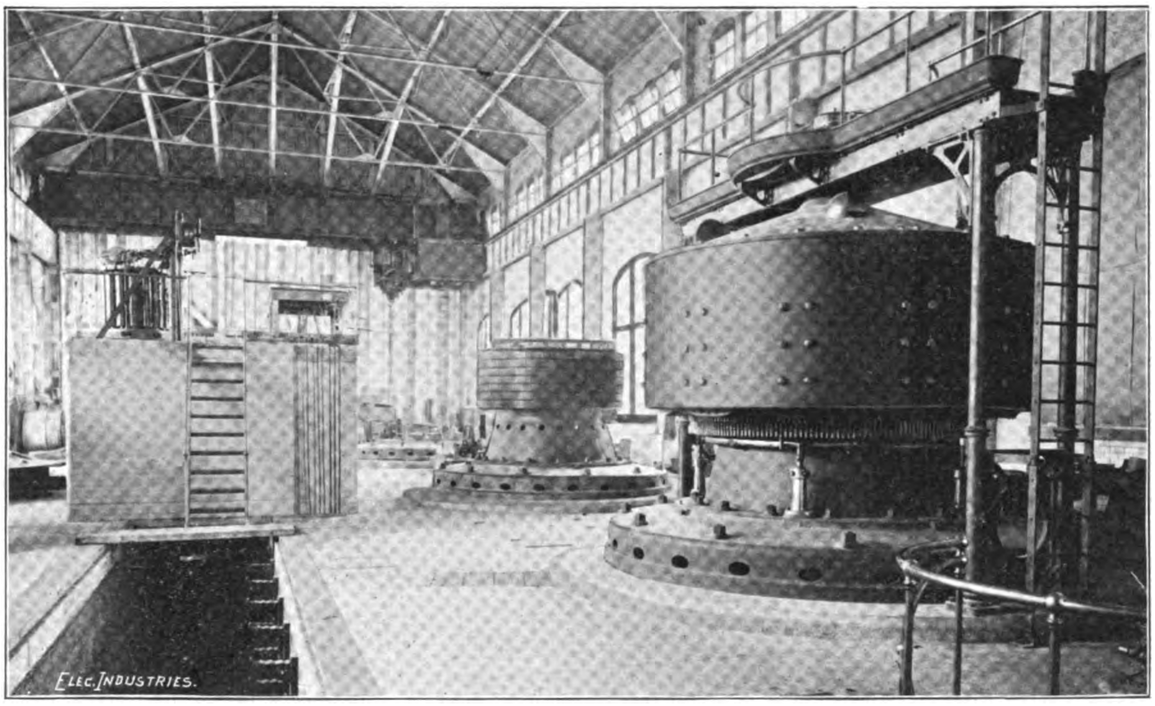


FIG. 1.—THE NIAGARA FALLS POWER PLANT—INTERIOR OF POWER HOUSE.

The construction of the surface canal starting from a point about one and one-half miles above the falls and running inland 1,700 feet, with a depth of 12 feet, the wheel pit and tunnels, the main tunnel being 7,000 feet long, 19 feet wide and 21 feet high, have been described in various journals devoted to those branches of engineering. This artificial waterway has a capacity sufficient to develop 100,000 horse-power, and the work has been done in the most substantial manner.

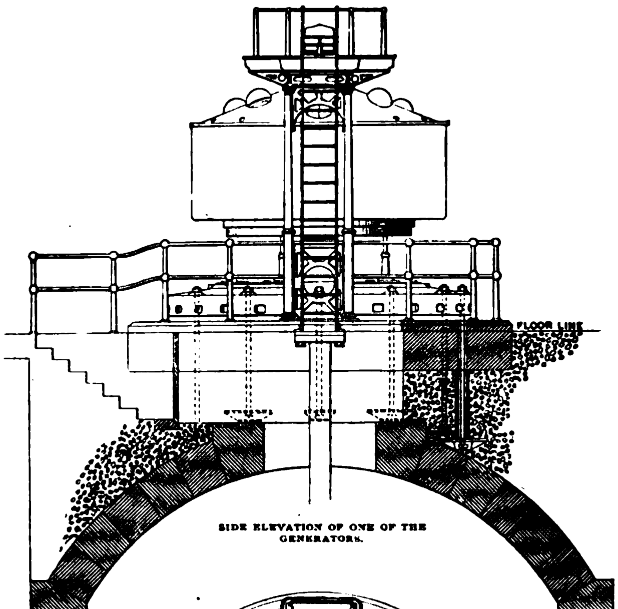
Through the work of the International Niagara Commission and of the various engineers employed the question of the best method of developing and transmitting the power was thoroughly discussed. The prizes offered brought out many worthy plans. As a result the units adopted were to be of 5,000 horse-power each, and the power was to be transmitted in the form of electricity. The design of the turbines was left to Messrs. Faesch & Piccard, of Geneva, Switzerland, and their execution to the I. P. Morris Co., of Philadelphia. The turbines were to drive vertical shafts as shown on page 210, with generator mounted on the upper end. The Tesla two-phase system of alternating currents at about 2,000 volts with a frequency of 25 per second was decided upon as the best system for this purpose after competitive plans and estimates had been invited and carefully examined. The final design for the generator was made from the plans in possession of the company, which were modified by the engineers of the construction company and of the manufacturing company, as the best practice seemed to demand.

The Westinghouse Electric & Mfg. Co., to which the contract was awarded for the first three generators of 5,000 horse-power each, has installed two of them, and the third one is under way. The work had advanced to such a point last month as to permit these great generators to be placed in operation and tested. These generators are on a par with the great enterprise of which they form a part, and indicate the latest advancement in dynamo construction.

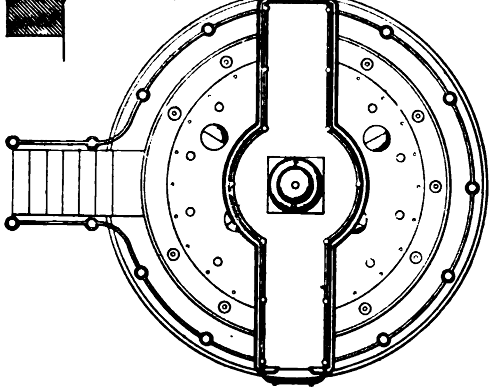
In Fig. 1 is shown a view of the interior of the power house with one generator completed and another in process of erection. The end of the switchboard and vault for cables, etc., are also shown. It is, however, with the great generators that the greatest interest centers, a more perfect view of which is shown in Fig. 2. This generator is over eleven feet high, with a bed plate 14 feet across, and weighs about 85 tons. The revolving part of the generator is the hood-shaped part, containing the poles which cover almost the entire machine. This hood, as will be seen in the cuts, has a number of openings in the top by means of which the current of air for ventilation is greatly increased.

The vertical section of the generator shows the interior construction of this hood-shaped part, viz.: a ring carrying on its inner surface the pole pieces and field coils with heavy supporting top which is keyed to the shaft. This part of the generator weighs a little less than 80,000 pounds. The field ring was forged from a single ingot of nickel steel without weld. Its tensile strength is not less than 70,000 pounds per square inch. The diameter is 11 feet 7 inches. The great strength was necessary in this part of the dynamo to carry safely the weight at 250 revolutions per minute, which gives a peripherial speed of 9,300 feet per minute. The pole pieces, which are of mild steel, are bolted by heavy bolts at regular intervals to the inner surface. These pole pieces are wound with conductors of a rectangular cross-section, and the coils are covered with brass ribbed boxes.

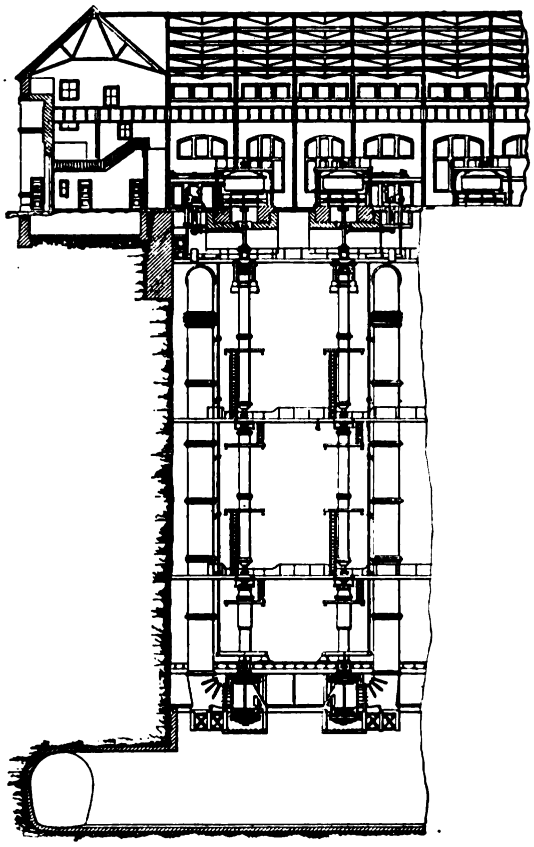
The driver is bolted to the top edge of the ring and is of mild cast steel. The heavy center bearing is strengthened by heavy ribs radiating from it. It is keyed to the shaft by which it is supported. Above the top of the hood are the brushes and collector rings by which the exciting current is conveyed to the fields. These rings are mounted on a separate casting which is securely fastened to the hub of the driver. The brush holders are held in place by a heavy iron bracket, encircling the casting below the collector rings, and are supported from the bridge which spans the machine.



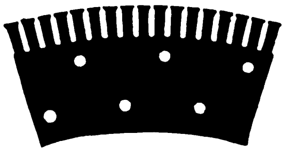
SIDE ELEVATION OF ONE OF THE GENERATORS.



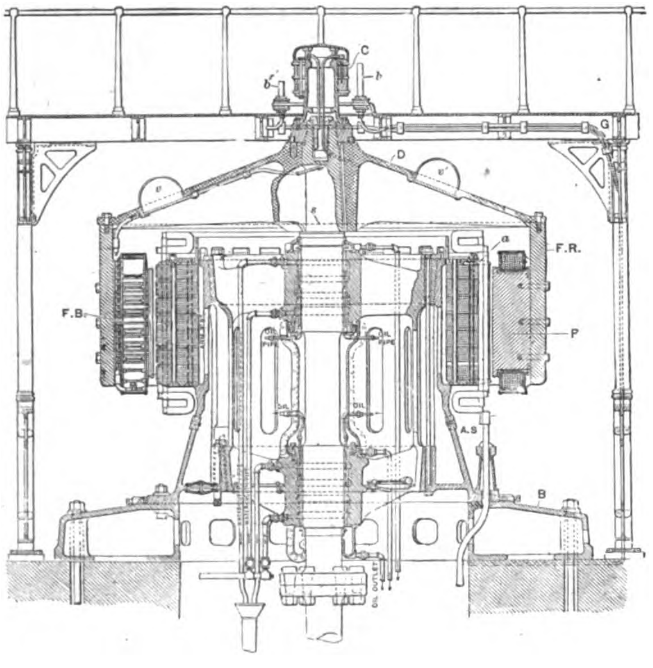
A TOP VIEW.



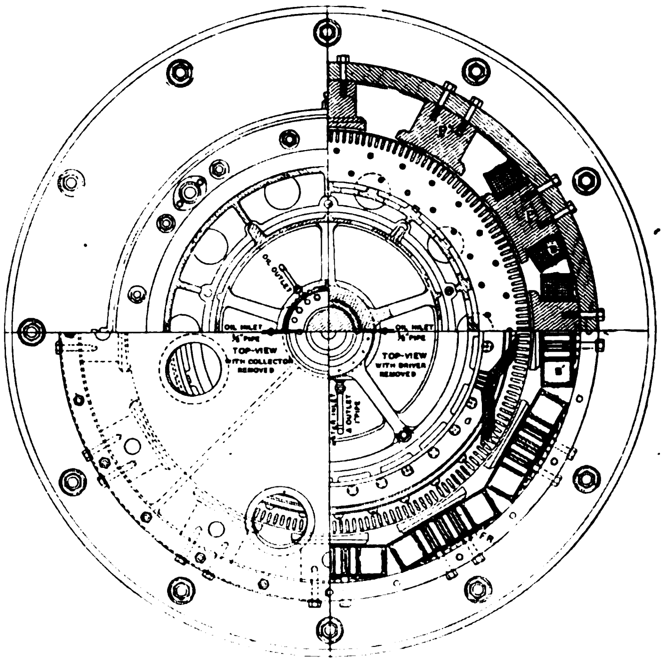
PARTIAL LONGITUDINAL SECTION OF THE POWER HOUSE AND WHEELPIT.



ONE OF THE SHEETS MAKING UP THE ARMATURE CORE.



VERTICAL SECTION OF ONE OF THE 5000 HORSE-POWER GENERATORS.



HORIZONTAL SECTION.

THE NIAGARA FALLS POWER PLANT—DETAILS OF GENERATOR.

Cuts from Cassier's Magazine.

The armature being stationary, it is rigidly mounted on a single cylindrical casting which is securely bolted to the bed plate. From the outer surface of this casting project a series of vertical ribs, ending at the bottom on a broad flange of the same width. The mild steel punchings, 0.015 of an inch, are annealed after being punched and the iron oxide, which forms on the surface is considered a sufficient insulation to prevent eddy currents. From these punchings the core is built up; eleven of the punchings just encircle the support. Each layer is laid so as to break joints with the one beneath. The core is divided into six sections with an air space between for better ventilation. The core is held together by 66 bolts of nickel steel. The metal is practically non-magnetic, and the bolts are carefully insulated, so that they do not interfere with the magnetic quality of the core.

The iron punchings are so built up that the serrated edge forms groves for the armature windings. These windings are copper bars, one and a third by one-half inch in cross-section. There are 187 slots in the periphery of the core and into each of these two bars are placed after being insulated. The insulation of the windings was tested to a potential of 15,000 volts at the factory. Mica is principally used for the insulation. These bars project above and below the core, and connections are made by pieces of copper punched from large sheets and pressed to proper shape. The connections were made by bolts and solder in a substantial manner, and the joints insulated with mica and rubber tape. In the process of soldering an electric welding tool was used which greatly facilitated the work. The windings, when connected, form two complete circuits, each insulated from the other. These two circuits are so related as to produce two distinct currents, whose electromotive forces are ninety degrees apart. Within the cylindrical supporting frame which holds the armature is a core which holds the spiders of the shaft bearings. These bearings have a spiral groove on their inner surface through which a stream of oil continually flows. The oil is filtered before it passes down the second time. There is also within the bearing a water course through which water may pass, should it be found necessary at any time to resort to artificial means for cooling the bearings.

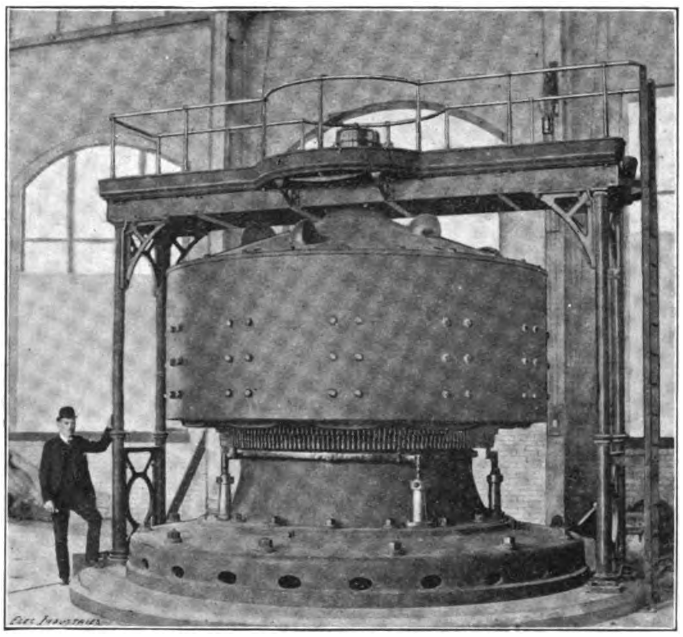


FIG. 2.—THE NIAGARA FALLS POWER PLANT—THE GENERATOR.

The power house is equipped with a 50-ton traveling crane by which any part of the generators may be lifted and carried the entire length of the room. The entire revolving part may be raised from the armature. The fields are excited by a rotary transformer, which supplies a direct current, and is operated by current from the generator.

An interesting point in the erection of these generators was the methods employed to balance exactly the revolving parts. It was known that if the field ring was not accurately balanced vibrations would result causing undoubtedly serious injury to the generator and its supports. A small piece of steel was set in the end of the shaft with its upper end cut out to receive the lower half of a steel ball, three-eighths of an inch in diameter. In the tapered bearing of the driver was fixed an eye-bolt with a similar piece of steel and a similar cup-shaped bearing. The driver was lowered upon this ball which supported it and allowed it to revolve. Any difference in weight was soon noticed, and balancing plates were fastened to the inner side of the driver to make up the difference. The pole pieces and field coils were accurately weighed before being placed in position in order to maintain the exact balance of the field ring.

The power house is designed for five, 5,000 horse-power generators of the type just described. But three of the generators have so far been contracted for, as the power desired from the station at this time is much below that amount. When the power has been used a sufficient length of time to prove to some of the too conservative manufacturers its cheapness and reliability this great power plant will be but one of several.

The switchboard of this plant differs as much from past practice as the generators. In Fig. 1 is shown a view of the switchboard structure. It is built over the subway through which the conductors run from the generators and from the switch board to the transformer house located across the canal. The material is glazed brick with a roof of slate supported on iron beams and in size is 57 feet 10 inches by 13 feet and 8 feet in height. Iron standards are secured to each side of the subway for supporting the heavy conductors. To provide for both local customers and those at a considerable distance two sets of bus bars are provided so as to meet any difference that may be desired in the two systems. The switches by which the dynamo circuits to either set of bus bars are closed, the arrangement being such that any dynamo may be used on either system, are of a special pattern designed for this plant. They are mounted on eye beams within the switchboard platform and are operated by compressed air.

Upon the platform are to be erected the cabinets for the instruments. These are constructed of marble supported on iron frames. In all cases derived currents or shunt currents are measured. The main currents do not reach the switchboard in any case. The instruments instead of being mounted on the face of the board are of a special design that enables them to be secured at the back of the slab with the scale and index projecting through an opening in the marble. The energy consumed in these instruments that measure the energy, the current and difference potential is said to be only about 30 watts.

The rheostats are placed in the chamber of the subway and leads to the terminals on the face plates on the instrument cabinets are run in the form of insulated cables. The bus bars are placed within the switchboard structure. They are constructed of heavy copper tubing and are strongly insulated. This form of bar was adopted on account of its permitting of better insulation and offering a greater radiating surface.

In the construction of every part of the equipment of this great power plant special and original work has been necessary. The results show that the manufacturers were equal to the task placed before them, which could only have been accomplished after the advancement which has been made during the past few years in alternating current generation. It is hoped that when the plant is completed and in working order that more of the details of the apparatus will be made public. It is about five years since the active construction work commenced but many years previous to that engineers were at work upon plans for generating and transmitting power from the falls. The present company was organized in 1886 but did not commence active operations until 1890, and five years later the first test of the apparatus was made.

The Sacramento-Folsom Power Transmission.

In the May issue of ELECTRICAL INDUSTRIES the power transmission plant at Folsom, California, was described. At that time the plant was approaching completion but no test of the system had been made. Last month the plant was placed in operation and current was delivered at Sacramento, twenty miles distant, for the operation of the electric railway and other purposes. The system is reported as operating to the satisfaction of all.

The transmission system will deliver 5,000 horsepower and about 1,200 horse power will be used at the State prison located near the power generating plant. This enterprise has been watched with a great deal of interest and its success will encourage other enterprises of a similar kind.

Electrical Industries.

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Communications on subjects of interest for insertion in any of the departments of the paper will be accepted for publication at the discretion of the editors. Articles from practical men on subjects relating to the construction, design, care and operation of electrical appliances are especially desired. Information of interest regarding new projects, new inventions or new applications of electricity is also thankfully received.

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IN this number will be found an article by Mr. A. W. Foster on "The Belt as Applied to Electrical Apparatus," which will undoubtedly be found to contain many points of interest to those who are connected not only with electrical plants, but also with other power stations using belts. The article is confined to belts used with electrical machinery, but many of the facts mentioned are applicable to all belting wherever used. After the selection of a belt its care is the next important consideration. In many power stations the different machines receive most careful attention. The bearings are kept oiled and are frequently cleaned. The surfaces are kept polished, the valves and gears are frequently inspected, but the belts are allowed to run until they run off or out. Belts are sensitive to neglect. They need to be kept clean and pliable. Dust and foreign substances work into the belt and either wear away its surface or dry up the belt, which requires at times a small amount of belt dressing. A belt is injured as much by too much attention as by no attention. Every engineer or attendant should understand the proper care of belts.

NEW appliances and processes are constantly being invented which change to a greater or less extent present methods. It is not true that all inventions have a commercial value, but if they supplant old processes or methods, or are utilized in new ways, that fact is sufficient evidence of their commercial value. An invention must possess some qualities giving it the preference over the old, or it would not be used. It may produce a better result or attain that result with a less expenditure of labor or capital; it may be more attractive, more pleasing to the eye, or it may be used simply because it is a novelty. Its value is not gauged by the amount of time, labor and capital consumed in perfecting the idea, but by its utility. The inventor is not paid for his time, but for the result at its commercial value. He may spend years on what proves to be of trifling value and only a few days on what gives him a fortune.

Inventors are commonly supposed to be endowed with a special genius and, as Prof. Gray says in a recent lecture, "The inventor is born, not made, but genius is principally hard work. There must be natural capacity, but this alone is not enough." Few inventions are produced spontaneously, but rather from the recognition of an evident need or opportunity. An outline of the future invention is first drawn and afterwards developed. The first outlines of an invention have been suggested to many, but not being considered of value, have been neglected, to bring to others later on a handsome reward. In the electrical industries invention has followed invention in rapid succession and numberless fortunes have been acquired through them. Electrical patents, if possessing any merit, have never lacked purchasers. They have always commanded a good price, proportionately larger than in any other industry, a fact that is partly due to an exaggerated idea of the possibilities of the applications of electricity and partly to the greater opportunities which the industry seemed to offer. An invention is usually worth developing if it gives promise of increasing the means of production, improving present processes or opening new fields. One should necessarily be acquainted with the records of the patent office in a line in which he contemplates work, lest he finds when too late that some one has anticipated him.

WHAT is the cause of death in electric shock, is a question that many have sought to determine. The investigations made so far have been in the study of the effects of electric currents on different animals and the examination of the bodies of criminals executed as prescribed by the laws of the state of New York. The same results have not been obtained by the different experimenters in all cases and therefore the conclusions drawn have not been the same. The exact knowledge now held on this subject is limited and each addition made thereto is quickly made use of in further experiments. When the cause of death is absolutely determined we may then look for a remedy or means of protection which will either restore or protect the victim of the electric shock. The methods for recusitation as advocated by d'Arsonval has in many cases been successful and were it not for the prompt application of this method many persons would not now be alive. Whether the current acts upon all persons alike has yet to be determined but it is held by many that it does not. Nor has it been shown that it acts upon the human body as it does upon the bodies of the lower animals.

AT the recent annual meeting of the American Institute of Electrical Engineers Dr. A. M. Bleile of the Ohio State University read a paper describing a series of experiments for determining the answer to the above question. For these experiments a number of dogs were secured and from the experiments on them the result was found to depend somewhat independently of the weight of the animal on three factors: On the voltage, on the amperage and upon the time of application. A variation of either one of these factors he found would change the result. The first conclusion drawn as the experiments proceeded was that the pneumogastric nerve stimulating those fibres which control the heart, in that they have the power of arresting its beat, when strongly stimulated was affected by the current. The heart and system of circulation were first examined and this conclusion was drawn from their appearance. Injections of atropine were made to paralyze these nerve fibres and thus to prevent their action on the heart when strongly stimulated. This was found not to render the animals more resistant and other causes were looked for. It was determined to test the action of the current on the nerve centers that control the diameters of the arteries. Hypodermic injections of nitroglycerine and nitrite of amyl were made, which affect powerfully the arterial system, causing a dilatation of the arteries. The animal was found to recover from shocks that proved fatal to others and subsequently to the subject itself after the effects of the drug had disappeared. It was thus shown that death in electric shock is due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that such an impediment to the flow of the blood is made as the heart is unable to overcome.

ELECTRICITY is being more generally used every year, its applications have constantly increased until it has entered nearly every industry. Familiarity with electrical apparatus and a full knowledge of the effects of heavy currents, together with the better construction and insulation of the conductors has caused the number of accidents to decrease proportionately rather than to increase. Accidents cannot be entirely avoided in any line of work and there will always be a greater or less number from the electric current. The use of high potential currents for the transmission of power to greater distances will possibly increase the proportionate number of fatal accidents. Should the results of the experiments made by Dr. Bleile be proven correct in the majority of cases or even in a portion of the cases of electric shock some means will be undoubtedly discovered for counteracting immediately this effect on the arterial system. The method of recusitation, which up to the present has been the only even partially successful method, should be tried in all cases and continued until sufficient length of time has passed to place beyond question the victim's death.

OF the many sources of power from which man has obtained for centuries the energy for use in the different industries the water fall has been given the preference. Around nearly every water fall gathered the buildings of a village or city, attracted by the power that when once harnessed costs little to maintain. As the steam engine came into use it was soon generally adopted because it could be used wherever fuel could be obtained. For many years the water falls were not so eagerly sought and many were abandoned on account of the disadvantages of their location or an unreliable water supply. Business centers increased in number and size on account of the advantages offered by a large number of manufacturing companies locating together where fuel and supplies could be readily obtained.

WITH the advancement made in electrical science and the growth of electrical generators and systems of distribution and transmission attention has again been turned to the water falls for the generation of power. Within the past few years many old water powers have been rebuilt and electric power plants have been erected on the ruins of the old mills. The power generator at small cost is transmitted in the form of electricity to the distant city or town where the advantages for want of which the old factory was abandoned, are found. Water powers at remote and almost inaccessible points are being developed to furnish the distant city power, light and heat at a moderate cost. The electric systems for the transmission of power have brought a revival of the water power in which there is wealth to those who develop it. In the east, south and west works have been undertaken on a grander scale than has ever before been attempted for the development of the water powers.

IN the address of Mr. Grimm, the new president of the Northwestern Electrical Association, at the opening of the convention last month the importance of a proper attitude on the part of lighting and similar corporations toward the public was well presented. Corporations, whose business is conducted by virtue of public franchises, too often neglect to show proper consideration for the public. This disregard for their rights has made the public suspicious of such corporations in general. The intentions, therefore, however worthy, are often misinterpreted. Neglect of the requests and wants of the public with this suspicion quickly arouses an antagonism that is hard to overcome. The opposition and friction when once started usually continues whether the causes remain or not unless a special effort is made to regain the good will of the public. Loss of patronage, opposition to extension of franchises and many impediments soon have to be met by the management. Corporations of this kind must deal differently with the public than strictly private companies. A more liberal and considerate mind must handle the reins. Not that every demand of the public must be conceded but that tact should be used so that the good will may be retained even when such demands cannot be complied with. Officials are often too reticent respecting the plans and affairs of the company and quite frequently this is true respecting even the business of the company.

THE great undertaking at Niagara Falls, which, when fully completed, will have a capacity of 100,000 horsepower of energy, stands unrivaled in the history of engineering achievements. While the power plant is not yet completed, the wonderful apparatus, which is to develop the power, has shown in recent tests the entire success of the designs, and assures the success of the enterprise. Few enterprises of ordinary size can show such a record in the design and the construction of the power machinery—a record showing no mistake of importance. This is all the more remarkable when it is considered that the engineers were entirely without a precedent which would form a guide, or from which data could be obtained. The wonderful progress which has been made in the generation of electricity and its transmission and distribution since this enterprise was started, is shown in the fact that the advantages of the many different systems for the transmission of power were each considered, and electricity was by no means the favorite, but, on the other hand, a well-known authority was confident that compressed air would be the system used, while at the present time no other system than electric would be considered. Various estimates have been made of the cost of the power delivered at the neighboring cities in the form of electricity, which, if proved to be correct in actual practice, would permit the Niagara Company to compete with local power to the entire limit of the capacity of the works now contemplated. It is doubtful, however, if we see in connection with this enterprise in the near future any very long transmission systems, since in the village of Niagara Falls and neighboring towns customers will be found for all the power that is immediately available. The subject is kept before the engineers of the world, and is being carefully studied, so that when it is found desirable to establish long transmission systems, the engineers will be able to meet the problems presented. The construction of these great works has given a great impetus in an industrial way to the country adjacent. The prospects of power at such low figures has attracted a number of large users, and a great manufacturing town will take the place of the village which has heretofore been known only as the resort of tourists and travelers, although possessing many important manufacturing industries, whose power is derived from the Niagara.

Factory Practice in the Design and Construction of Dynamos.—IV.

BY C. E. WOODS.

We will first ascertain the radial depth of armature: As the armature core is to have a gross length of 10 inches from which we have to deduct 10 per cent, which will be the space occupied by insulation on the armature discs, it will leave the net length of armature only 9 inches; 31.2 square inches is required so we have to divide this number by our length, 9 inches, which gives us 3.46 inches radial depth.

The length of pole extending from rim or yoke of machine to the armature is simply a question of space for the accommodation of the field winding, and we first have to obtain same; in conjunction with this we first obtain the length of the air gap, which is as follows:

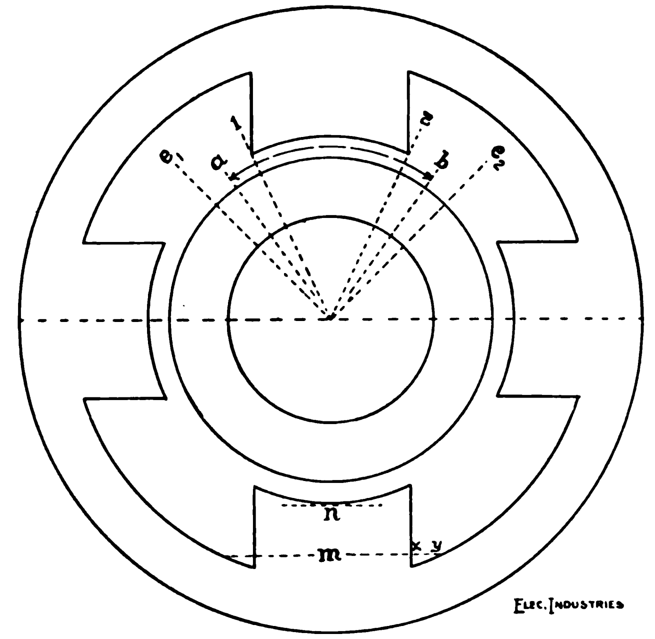

FIG. 11.

The thickness of the insulation in mils on the armature core will amount to 40 mils, the diameter of our armature wire 156 mils, depth of binding wire and insulation for same 70 mils, and clearance between pole tip and top of binding wire is 60 mils, which gives us a total length of air gap of 326 mils. The total air gap for one magnetic circuit will be twice this length, as it must, of course, be the same distance under each pole, which is 652 mils, and what we wish to know at the present moment is how many ampere turns it will take on the field, to force the magnetic flux of 3.546,000 lines of force through this air gap of 652 mils; this is obtained by the following formula: Total flux multiplied by length of air gap, divided by the area, multiplied by one, multiplied by 0.3132.

The area of the air gap seems to have been a very much misunderstood factor, and that it may be clearly understood by those interested in this article we will endeavor to go into it in a little more detail. Referring to Fig. 11, the peripherial width of the air gap is from A to B, and not from 1 to 2 as is calculated by many people, A and B being the mean peripherial width between E^1 and E^2, which in our case is, taking the arc of the circle as it is, E^1 and E^2, 11.5 inches, and 1 to 2, 5.7 inches, a difference of 5.8 inches, and as A and B are half of this, it makes an increase of 2.9 inches, which added to 5.7 inches gives us a total peripherial width of air gap of 8.6 inches; this multiplied by 10 inches in length gives us 86 square inches as our air gap, and writing our formula in plain figures we have the number of ampere turns required to force the magnetic flux through the air gap, which is 8250. It must be understood that all insulating material, copper, etc., which fills up the air gap are in relation to the magnetic flux the same as air.

For the present moment to omit mathematical complications we will say that for the iron portion of the magnetic circuit 25 per cent more ampere turns are required, which gives us a total number of ampere turns 10,312.

As there are two poles to each magnetic circuit, we divide this by 2 for the number of ampere turns per pole which makes 5,156, and as a machine of this kind would have about three amperes in the field it would give us 1,718 turns of wire per pole. Allowing three amperes to flow in the field the total resistance for the field for 125 volts will be 41 ohms; as a certain portion of this resistance must be in the rheostat, which portion must be such as will allow approximately one-fourth more current to flow, we allow 10 ohms resistance for the rheostat, making a net resistance of the shunt winding 31 ohms, which will allow a maximum current of four amperes to flow, when rheostat is all cut out.

The mean length of one turn of wire would be for calculation, 12 inches for the length of the pole twice, and six inches for the width of the pole twice, averaging a mean length of three feet for each turn, which multiplied by 1,718 turns would give us total length of 5.154 feet per spool, and for four spools, 20,616 feet. As we must have a wire now, which will give us about one and one-half ohms per thousand feet to get our 31 ohms, the nearest to which will be found upon referring to a wire table to be No. 12 wire which is 1.58 ohms per thousand feet, which will make a total resistance, when multiplied by 20,616 feet of 32.5 ohms. The diameter of this wire insulated is 90 mils which will allow about 11 wires to the inch. If we allow our coils to be two and one-half inches thick, which they can be and slip on the pole projections, will give us 28 wires, and as we have to have 1,718 wires in all, this divided by 28 will give us the number of wires high the coil will have to be, which is 62 wires, making about six inches. From this it will be seen that our poles will have to project from N to M for the shunt winding, six inches, allowing X and Y to be two and one-half inches.

Boiler Feed-Waters; Their Treatment.

In a paper by Mr. W. D. Jameson, read before the Northwestern Electrical Association, the various impurities met with in boiler feed-waters such as salts of lime, magnesia, potassiun, iron, silica and aluminum combined with hydrochloric or sulphuric acid, were described. The only substance, the author states, to break up these sulphates of lime in a form that can be washed out of the boiler are sugars properly blended. When used under the conditions found in a steam boiler, the sulphates of lime are converted into carbonates, and if tannin is present into tannates. The injurious effects of electrolysis or galvanic action in the boiler was particularly mentioned and while considered one of the most harmful was the easiest treated since the addition of vegetable starch and saccharine matter was found to break up the conductivity of the water forming a connection between the brass connections (negative) and boiler plates (positive). These ingredients, crystalizing and forming scale, are converted by proper treatment into tannates and saccharates, which are non-crystallizable and are simply soft mud easily removed, having no affinity for the heated surfaces.

Among the novelties in electric incandescent lamps is a lamp with a mirror placed inside the globe. The mirror throws the light out from the base in the direction the light is required. An inventor of Florence, Italy, is the originator of this novelty.

Sixth Convention of the Northwestern Electrical Association.

The mid-summer meeting of the Northwestern Electrical Association passed off very pleasantly. The program as arranged both for the meetings and by the entertainment committee was carried out in every particular. The first session was called to order the morning of the 17th by Mr. Geo. Grimm of Jefferson, Wis., the vice-president of the association. In his address he paid the following tribute to the late president, Mr. H. C. Thom:

"Since custom demands that your presiding officer shall present a brief address at the opening of the convention, I will endeavor to perform my duty. Were it not for the sad event which has touched our hearts with deepest sorrow, this duty would today devolve upon another; and were it not for the love I bore for my departed friend and the wish to pay tribute to his memory, I would prefer to ask one more competent to the chair.

"When memory takes us back to last January, when, by unanimous consent, Henry C. Thom was elected president of this association; when we see his cheerful, ruddy, kindly face beaming with good will and whole-souled manhood, his sturdy form as erect as a young oak, and hear his voice so full, firm and pleasing, it becomes hard for us to realize that we shall never see him again. There is that in the character of a truly noble man that casts its hallowing influence upon all those who approach within its circle and irresistibly compels the heart to love and trust. An influence emanates from him that leaves its charm forever potent in the memory; that gladdens while we weep, and enriches our lives, though impoverished by loss.

"I knew Mr. Thom for many years. I saw him steadily and resistlessly, by his force of character, win high position, and by his sterling manhood win friend after friend, until few men, if any, could find a warmer or wider welcome in his state. Eulogy in words seems weak and futile to those whose hearts offer a eulogy more tender, more loving, more eloquent than their lips can offer. Those who have looked upon his countenance and heard his voice cannot forget him if they would, and those who did not know him cannot, by any description of him, however truthful, form an opinion of him that would do him justice. He has gone from us; we grieve at our loss, and the world is better for his having lived in it. What more should be said, what better tribute can we pay? Though his years were few, his influence will remain and perform the good work which he could not complete. It is a blessed truth that even the bitterest sorrow for a departed friend is leavened with sweetness; and though the heart may bleed, it turns again and again to recall his memory and its controlling power, until, like an influence from beyond the grave, it slowly melts the most poignant grief and leaves only the sweetness of loving remembrance.

"To those who stood so near to him and cherished him as no others can, to the wife of his bosom and loving children, we extend the sympathy of friendship, and pay him that tribute all strive to merit, but few with success, that the world is better for his having lived in it."

In referring to the work of the association the consideration which should be shown the public by corporations of a semi-public character was well brought out.

"The very basis of this government is equal justice to one and all, not as an idle phrase printed upon a statute book, but as a principle living in the heart of each individual. If, therefore, we see an evil growing in the community, one that works injustice or injury, we should find the cause that has dulled the sense of justice in the people and permits the evil to exist. In our case the cause should not be hard to find. How many corporations who are enjoying valuable franchises granted to them as gifts by municipalities conduct their business with any other thought or object in view than the profits to be made? They will improve the service or extend their lines if they must, or if they can gain additional patronage; but every move is actuated either by expected gain or public (municipal) compulsion. Complaints of poor service, irregularity, overcharge, and the like are utterly ignored, until recognition is compelled by public sentiment or authority. Competition is kept out, destroyed or made harmless by combinations. Every effort is directed to the earning capacity, frequently for the purpose of forcing, by its dividend-paying qualities, a stock, originally watered, up to par. Every concession requested by the community that gave it the possibility of existence is resisted until the patience of the public is exhausted and sentiment becomes inimical to an industry that should have received united support and commendation.

"The sentiment of dislike and clamor for municipal ownership of the quasi-public industries like electric lighting, gas works, water works, and the like, is the natural outgrowth of either unduly large profits extorted by the line of policy above referred to, or by lack on the part of the managers of proper regard for the rights of the people. I fail to find any other cause. The root of it all is that some of these corporations seem unable to realize that their business is not strictly private, but semi-public in its character, and should be managed accordingly. While undoubtedly most of these industries are run upon a broad gauge plan, regardful and mindful of the rights and wishes of the public, yet it must be evident to all that there are many that are liable to every charge of the evils complained of. The public never stops to discriminate in passing judgment, and the result is, that the general sentiment becomes hostile to all alike, and ready to accept any plan of relief or retaliation which may be suggested, even as against industries which are not at fault and which would innocently suffer. Thus the agitator and pot-house politician find ready soil to receive their seeds of communistic doctrine and willing ears for the abuse of others and self-glorification.

"It is to this subject that I invite your consideration both as individuals and as a body. We are dependent upon the public good will; a contest is destructive to our interests. We should use our influence in every possible direction to gain and hold this good will. The business is hazardous at best and we cannot afford to add additional risks, such as public ill-will would bring."

Various matters of business and the papers by Mr. J. S. Stephens on "Central Station Economies," and by Mr. A. V. Abbott on "Electrical Interference" took up the time of the first session.

Tuesday's session showed a larger attendance than the previous day. The first paper was by W. D. Jameson, on "Boiler Feed Waters and Their Treatment." The paper entered into the composition of waters used in boilers, describing their complex nature and the formation of scale and precipitants in the boiler. The treatment of feed waters was treated at considerable length. A paper on "Electric Street Lighting" by Mr. George Cutter received close attention and a very interesting discussion followed. Friday's session opened with a paper on "Boilers and Suggestions for Boiler Specifications," by John C. McMynn. Many interesting points were brought out which were discussed at the conclusion of the reading of the paper. Prof. Jackson's paper on "The Choice of Transformers and the Necessity of Testing Before Placing Them on the Line," was read by Mr. T. R. Mercein, the author of the paper being unable to be present.

Mr. George Grimm was elected president, Mr. Pliny Norcross first vice-president and Mr. P. H. Korst second vice-president. The entertainment committee appointed for the next meeting, which is to be held in Milwaukee, January 1896, is composed of Messrs. Herman Andrae, O. M Rau and Walter C. Smith. After announcing that the annual meeting would be devoted strictly to business and educational matters, upon the motion to that effect the convention was declared adjourned.

The program of the entertainment committee took up every afternoon and part of the evenings. It was well arranged and provided a pleasant outing for those who were able to accompany the excursion parties. The visit on Wednesday afternoon to the large electric plants in the city, including the Chicago Edison Harrison St. station and the Metropolitan West Side Elevated, was most enjoyable. The Drainage Canal excursion via the Santa Fe gave the visiting delegates an opportunity of seeing not only that great artificial water way but also the use of electricity on large works of this kind. The theater party in the evening was attended by about 130 and not only the "Merry World," but the special hits for the benefit of the members of the association present were greatly enjoyed. The drive through the parks and boulevards was the program for Friday afternoon, and the original plans and more were carried out. Invitations from the Chicago Telephone Co. to visit the exchange, and from other companies were received, and many accepted the courteous invitations extended.

Electric Locomotives on the B. & O. Railroad.

It is certainly a novel sight to see an electric locomotive hauling on a standard steam road, an entire train including steam locomotives; but such may be seen on the B. & O. railroad at Baltimore. The electric locomotive on the standard railroads has been predicted for several years, in fact, since electricity began to be used for traction purposes, and at the present time has been realized. When such predictions were first made they were generally given the same consideration as air ships and similar devices. It was considered possible, but not probable that such wonderful improvements would be made in the near future. As the systems of electric railways were developed, and important results were attained, the day of the electric locomotive of a power equal to the steam locomotive did not seem so far off.

The completion and satisfactory trial of these electric locomotives on the Baltimore & Ohio railroad is perhaps but the beginning of a successful career of the electric locomotive in these fields. The electric locomotives were adopted for service only in the tunnel which has recently been constructed under the city of Baltimore. When steam locomotives are used the smoke and steam fill the tunnel, making it decidedly unpleasant for passengers and trainmen. A number of schemes were presented for hauling the trains through the tunnel, but electricity seemed to satisfy every requirement. The tunnel was the only means of reaching the center of the city open to this road which previously made a circuitous route and across the river by ferry.

The electric locomotives are used to haul the trains a distance of about three miles, including the approaches to the tunnel and the tunnel. They are designed to haul 500-ton passenger trains at a speed of 35 miles an hour, and freight trains of 1,200 tons at 15 miles an hour. The tunnel has a uniform grade of 0.8 per cent. The contract for the equipment was awarded to the General Electric Co., and the locomotives were built at the Schenectady Works. The equipment includes a lighting plant for lighting the tunnel and approaches. The power house is at Howard St. near the tracks, leading to the tunnel from the south.

Fig. 10 shows an interior of the engine room, which is 223 feet long and 58 feet wide. The engines are the Reynolds-Corliss, built by the E. P. Allis Co,, of Milwaukee, Wis. They are directly connected to G. E. 500-kilowatt generators. The generators differ slightly from the regular power generator. The armature is overhung on the outer end of shaft; is of the iron-clad type, and wound for 700 volts. The current is carried by heavy cables of one million C. M. cross-section to the line from white marble switchboard which is mounted on a gallery at the end of room. The lighting plant, which consists of eight fifty-light arcs and two alternating current dynamos, is placed at the other end of station. These dynamos are driven by cross-compound Armington & Sims engines.

The boilers are of the Root water-tube type made and erected by the Abendroth & Root Mfg. Co., and are twelve in number of 250-horse power each. A system of mechanical draft is employed. The fans of the Sturdevant pattern are driven by a ten-horse power engine at 240 revolutions per minute. The iron stack is but 50 feet high. The coal is handled by a Hunt coal conveyor which also takes away the ashes.

Contact with the overhead conductor is effected by means of a sliding shuttle-like shoe of brass, which is fixed to a flexible support fastened to the top of the cab. This "trolley" support is a diamond shaped and compressible, con-

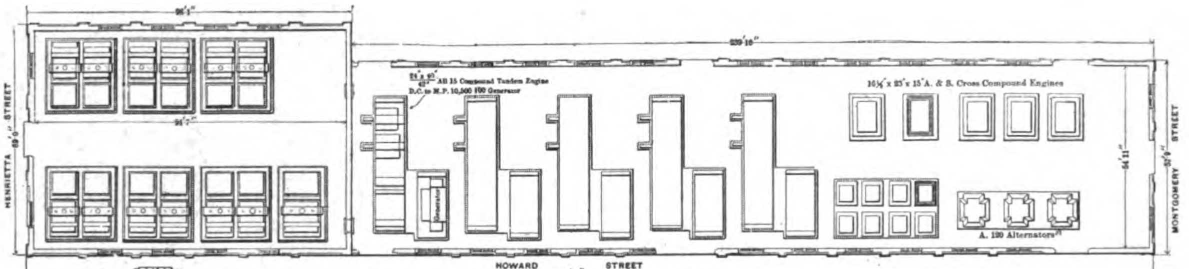
HENRIETTA ST STREET
MONTGOMERY STREET
HOWARD STREET
337'11"
339'10"
54'11"
24" x 42" AB 15 Compound Tandem Engine
D.C. to M.P. 10,500 100 Generator
16½" x 25" x 15" A. & S. Cross Compound Engines
A. 120 Alternators
Generator

FIG 1 PLAN OF POWER STATION.

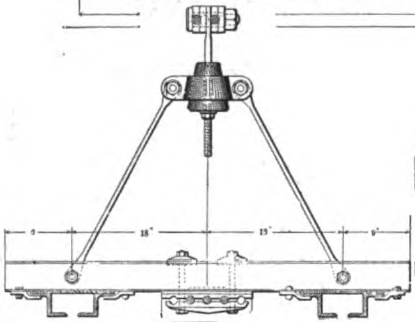

FIG 3

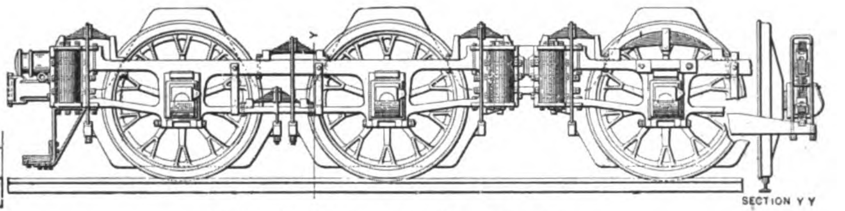

FIG. 2 TRUCKS, SHOWING METHOD OF COUPLING.

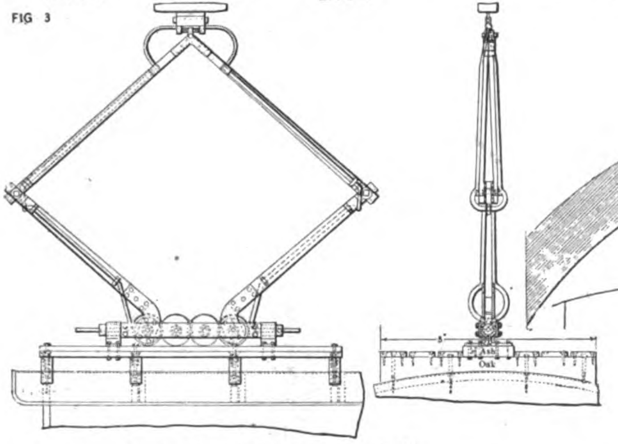

FIG. 4. SIDE AND END VIEWS OF TROLLEY

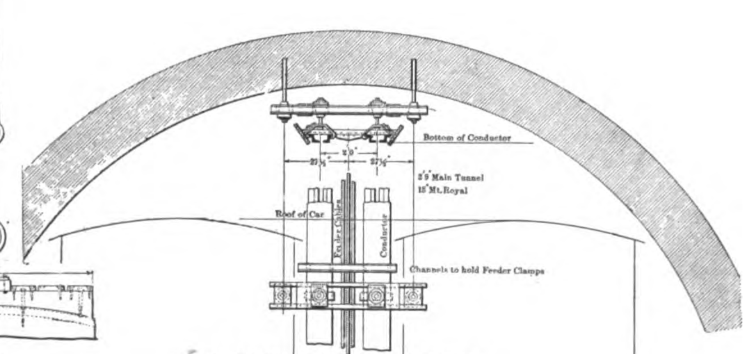

FIG. 5. SECTION THROUGH MAIN TUNNEL

FIGS. 1, 2, 3, 4 AND 5.—ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD.

tracting and expanding as the height demands, and is arranged to lean on one side or the other as the locomotive runs on one side or the other of the overhead conductor. It is, however, rigid in so far as movement forward or backward over the locomotive is concerned. The current is brought to the locomotive by means of cables connected to the shoe and fastened to the "trolley" support. The conductor is simply a reversed iron conduit or trough erected overhead on trusses in the open and in the tunnel attached to the crown of the arch. In the open the conductor is directly over the center of the track; in the tunnel over the center line of the space between the tracks. It extends from Henrietta Street on the south to Huntington Avenue on the north, a distance of 15,000 ft.

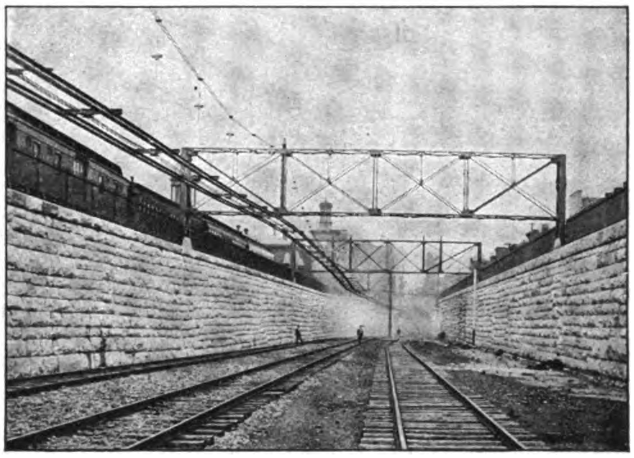

FIG. 6—ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD—OVERHEAD WORK IN CUT.

The conductor, as shown in Fig. 3, consists of two three-in. iron Z bars three-eighth in. thick, riveted to a cover plate one-fourth in. thick and 11½ ins. wide, and is constructed in sections 30 ft. long. It weighs about 30 lbs. per foot. At intervals of 15 ft. inside the tunnel there are suspended from the arch, transverse frames, consisting of two three in. channels, held together by plates four ins. wide, and holding four castings into which are fitted conical porcelain insulators. In the masonry of the tunnel are fitted the bolts necessary to support these frames. They are two ft. six ins. long, have split ends, and extend 12 ins. into the masonry. The bolts pass downward through the outside pair of insulators. The bolts attaching the conductors to the channel frames pass through the inside pair of insulators and support an iron stirrup in which the conductor hangs. This method affords a double insulation, and if leakage occur it can only be by the current passing the insulators between the conductor and the transverse channel, and then the insulation between the channel and the bolt in the tunnel arch. There may be a defective insulator either on the roof bolt or on the bolt which supports the conductor, but only when two insulators on the same transverse channel frame are defective will leakage occur. The height of the conductors above the level of the top of the rails is 17 ft. 6 ins. in the tunnel, and they are fixed a little on each side of the center line. This plan was adopted to avoid the risk of the conductors striking brakemen who might be standing on the top of passing freight cars. An additional precaution is provided in the shape of continuous wooden shields fastened to the iron stirrup which supports the conductors.

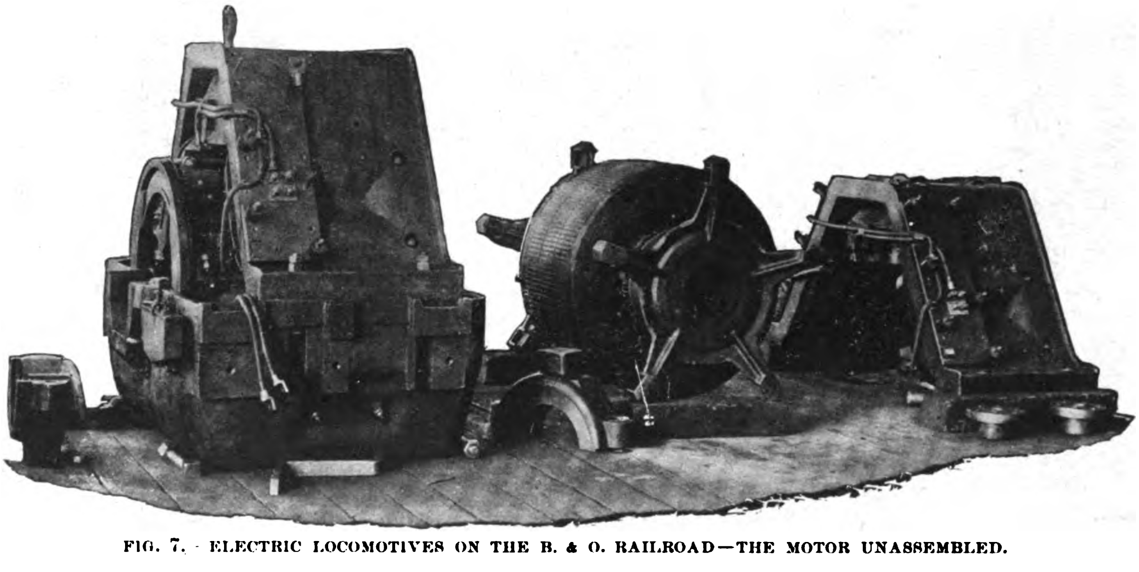

FIG. 7. ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD—THE MOTOR UNASSEMBLED.

Outside the tunnel the height of the conductors above the rails is increased to twenty-two feet. The supporting structure in the open consists of longitudinal catenaries of two chains of iron rods, having a span of 150 ft. suspended from tranverse trusses, supported by columns of latticed steel channels erected on either side of the double track. The catenaries pass over the top chord of the transverse trusses, and are fastened to a yellow pine timber post, acting as an insulation set therein. From the joints in the catenaries vertical rods are dropped at intervals of fifteen feet to support the electrical conductors. The vertical rods are attached to a casting holding a porcelain insulator, and through this a short bolt passes up to the joint in the catenary. The double insulation is secured by this vitrified porcelain insulator and the timber post, passing through the transverse girder. A hood of galvanized iron is fixed to the top of the timber post. At the ends of the line an anchor pier receives the ends of the conductors. The trusses vary in length from 30 ft. to 62 ft., the latter being required to span five tracks. All the iron work was made by the Maryland Steel Company.

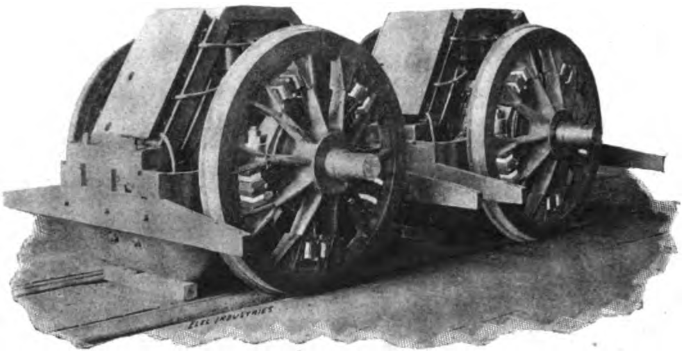

FIG. 8.—ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD—THE TRUCK.

Upon the straight track the conductors are suspended from single catenaries, while upon the curves a double catenary is employed, and the conical insulator is inverted and supported in a casting bolted to the two vertical rods which drop from the catenaries. The vertical rods support a channel frame to which are bolted the conductors and the feeder cleats or clamps. Each joint of the conductor is bonded with a Chicago bond of two No. 0000 wires. The feeder cables are of bare stranded copper of sixty one strands each of 1,000,000 C. M. cross-section. These are supported in iron cleats fastened to channel frames riveted to the overhead conductors at points near to the heavier channels to which the conductors are suspended.

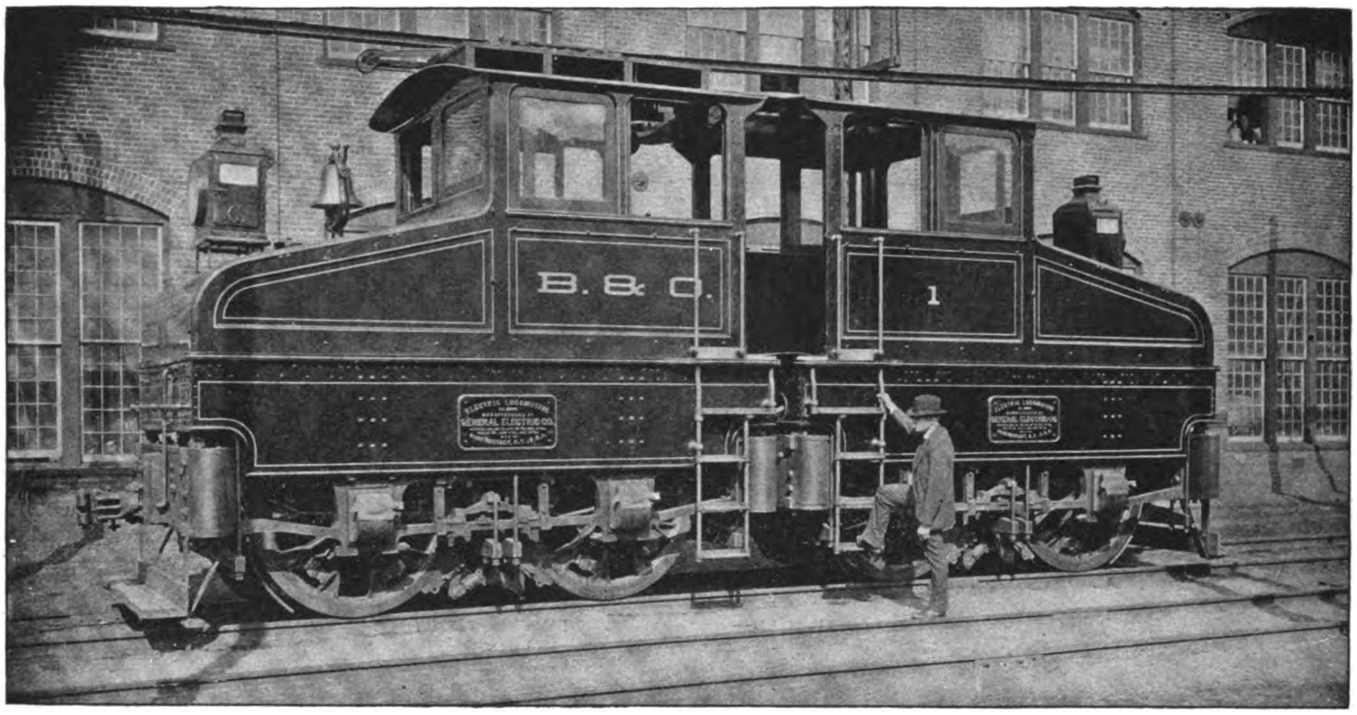

FIG. 9.—ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD—THE LOCOMOTIVE.

The motors are the largest constructed for railroad service, and as they are the vital parts, possess the greatest interest. One of the motors dismantled is shown in Fig. 7. There are four of them to each locomotive, mounted on two trucks which are flexibly connected. They are of a six pole type. A corresponding number of brushes are so arranged as to make a complete revolution about the commutator, an arrangement that facilitates repairs or inspection. The field yoke is of a pyramidal form and the pole pieces are bolted to it. It is a powerful field and its entire weight is made use of. The field coils are wound in sheet iron cases which fit over the pole pieces. The motors are carried on supporters bolted to the field ring, which rest on adjustable hangers that in turn rest on half-elliptical springs placed on top of the frame and bumpers. The motors are thus flexibly supported.

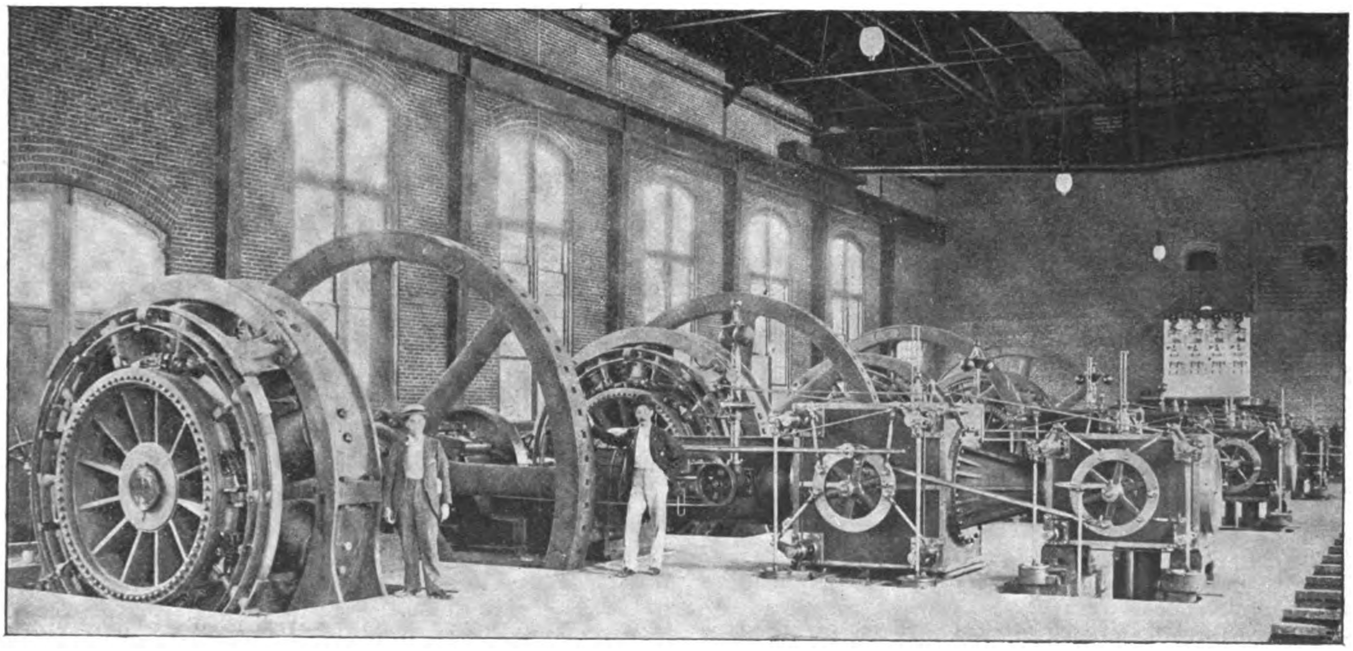

FIG. 10.—ELECTRIC LOCOMOTIVES ON THE B. & O. RAILROAD—INTERIOR OF ENGINE AND GENERATOR ROOM.

The armatures are of the iron-clad type with the windings imbedded in insulated slots in the core. This core is made up of sheet iron punchings, which are put together in the usual way. A very good quality of iron was selected and as completed, the core shows very fine laminations. The armature is mounted upon and keyed to the hollow shaft, which is carried on the journals on the truck frame. This is clearly illustrated in Fig. 7. The inside diameter of the sleeve is about two and one half inches larger than the axle, which gives the armature room for the yielding of its flexible supports.

In the connection of the armature to the drive wheels a departure was made from the usual practice. Gears were entirely discarded and the plan adopted was permitted by the slower speed of the six pole motor. Another point gained was the flexibility which relieves the armature of sudden jars from inequalities of track and also a less sudden pull on the start. As will be best noted upon referring to Fig. 7, there is keyed to each end of the sleeve on which the armature is mounted a five armed star. Each arm when the armature is in place, rests between rubber cushions in the drive wheel, a special form of drive wheel having been devised. The drivers are 62 inches in diameter, inside of tire. The rubber cushion is forced into the arm and cast iron wearing cap. The drivers are cast steel pressed and keyed to the axle. The tires are three inches thick at centers and are shrunk on. The axles are of open hearth steel.

The journal bearings are outside the drive wheels and in general design embody many features of the locomotive and passenger car-box. The bearings are phosphor-bronze. Sand boxes and Westinghouse automatic brakes are provided. The wheel base of each truck is six feet, ten inches. There are two motors to each truck and four to the locomotive. The entire weight, which is 96 tons, rests on the eight drive wheels. The two trucks are joined by heavy forged iron plates with oak bumper beams between them.

The cab is placed over the center of the two trucks with sloping ends, on which are placed the head lights, bells, etc. It is built of sheet steel, with windows at the sides and ends. The doors are at the center and iron steps at the side enable the trainmen to reach the interior of the cab. The air reservoirs are placed at the ends. The arrangement of the cab is such that the commutators are at all times visible and all parts of the motors may be inspected.

The cab also contains all controlling devices and instruments. A series parallel controller occupies one part of the cab. This controller contains the usual combinations with safety catches, reversing lever, etc. There are also an automatic circuit breaker, magnetic cut-out, a Weston ammeter and voltmeter. The air pump is operated by an electric motor which is controlled by an automatic switch.

Electric Power in Factories and Mills.*

BY F. B. CROCKER, V. M. BENEDIKT AND A. F. ORMSBEE.

The application of electric power distribution to the operation of factories and mills, including the driving of the various machines and other apparatus, is the latest and one of the most important problems towards which attention is now being directed, the question being one of extreme prominence both from an economical as well as from an engineering standpoint.

In comparing two or more different systems of power distribution, the fundamental basis of comparison is generally that of dollars and cents. This is certainly correct, as far as it goes, but unless a very decided difference be found between the costs of running under the various systems, it may be found that other factors enter; factors which cannot be estimated in dollars and cents, namely, questions of desirability and convenience. Without considering any tests whatever, there are several exceedingly advantageous points in the use of motors in factories which are almost self-evident, such as: 1. Clear and unobstructed passages and head room, the latter facilitating the use of traveling cranes. 2. Ease of shifting the tools from place to place, possibly necessitating the placing of a starting box and the putting up of a little extra wire, as compared with the inconvenience and trouble of setting up and adjusting a line of shafting, hangers, belts, etc. 3. The economy due to the ability to run a single tool without necessarily starting the whole factory or at least a complete section. 4. The running expense is entirely stopped when the tool is shut down. 5. The absence of the drip of oil from overhead shafting. 6. The tools may be placed at any desired points almost regardless of the distance. 7. It is not necessary to arange the tools parallel as in the mechanical system. 8. A wider range of speed is possible. 9. Less damage caused by a fuse blowing than by a belt slipping off in case of accident or excessive load.

Considerations like the above have great weight in deciding a question such as that under discussion, and there is no doubt whatever that in most cases they rise to such prominence that they warrant a complete change from the old system to the new, even though there is no gain in economy or increased output. In most cases, however, it has been conclusively shown that considerable saving and increase in production is obtained, one test showing a very considerable percentage of increase in the output. The partial, if not the complete, displacement of the old method by the new is only a question of time, and it was the appreciation of this fact that induced the authors to undertake the determination of the power actually required to run the various tools and machines as used in ordinary practice.

Tests of the electrical equipments at the works of the Crocker-Wheeler Electric Co. and of the De La Vergne Refrigerating Machinery Co. were here described. The following tables show the nature of the equipment and results of the tests:

TESTS AT THE CROCKER-WHEELER FACTORY.

No. of Test.	Size of Motor.	Number of tools driven by motor.	Average Amps.	Average H. P.	Remarks.
1	1.5 H. P.	1 boring machine.	8.3	1.23	
2	1. "	1 drill press.	2.85	.42	Less than ½ full load of motor.
3	1. "	1 " "	2.86	.42	
4	1. "	1 " "	1.9	.28	
5	1. "	1 punch press.	4.86	.71	
6	1. "	1 gang drill.	4.75	7	Drilling ¼ in. and ⅜ in. holes.
7	3. "	2 machines.	10.04	1.48	
8	1. "	6 "	5.86	.86	All small machines.
9	3. "	7 "	13.36	1.97	
10	3. "	8 "	9.92	1.46	
11	7.5 "	2 "	33.1	4.87	Required 2.3 H. P. to run shafting only.
12	10. "	20 "		4.78	Tested by watt meter.
13	3. "	5 "	7 0	1.03	
14	3. "	1 engine lathe.	11.4	1.68	Light cut taken by tool.

TESTS AT THE DE LA VERGNE WORKS.

1	15. H. P.	1 planer.	20.08	5.11	Planer 10 in. x 9 in x 22 in. Voltage 190. ⅜ in. drill.
2	5. "	1 drill press.	4.07	1.23	Voltage 215.
3	10. "	1 boring tool.	14.47	4.17	Voltage 215.

The result obtained in these tests show that the power required to drive machine tools has been considerably overestimated, for it will be noted that with a large majority of the tools tested, the motor was not more than one half loaded, and in these cases it was seldom that the load equaled the full power of the motor, even for an instant. In the case of the large planer, although the motor was overloaded 50 per cent upon reversal of the bed, the average load was only one-third of the rated full load. With this machine, however, when the piece of work is very short, necessitating more rapid reversals, the average load will be much nearer the most economical output of the motor.

The question of running machine tools by individual motors or grouping a number of machines together and driving them by one motor, does not seem to allow of a general solution. It would not be advisable, for example, to use the individual system where there are a number of small tools, each one of which requires only a small fraction of a horse-power. On the other hand, if we have a large tool that requires considerable power, it would seem to be far more economical to run it by a single motor, using as little belting and shafting as possible.

In introduction of the electric system of distribution of power in the cotton industries of New England is now fairly begun. Although there are no large mills driven entirely by this system, a number of them have an electric plant and certain sections of the mill are driven by motors. An electric plant was installed four or five years ago in the works of the Silver Spring Bleaching and Dyeing Co., at Providence, R. I., but it was intended chiefly for lighting. But motors were placed in the carpenter and repair shops, and several other places, until at present there are about 100 h.-p. of motors installed in eight units.

A visit was made to the works of the Donnell Manufacturing Company, at Pawtucket, R. I., where a very fine electric plant has very recently been installed to drive the calico printing machines. The problem of running this class of machinery by electric motors has been a very difficult one to solve, for the motor must be capable of running at a number of different speeds and running constantly at any given speed with a variable load. In this case it has been solved by the use of a modification of the Leonard system of motor regulation. The outfit for each printing machine consists of a motor and a dynamo of the same size, the field rheostat of the dynamo being placed alongside the printing machine. The speed of the motor is thus changed by varying the voltage of the particular dynamo which supplies it with currents.

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* Abstract of paper read at the annual meeting of the American Institute of Electrical Engineers.

This plant has been completed but a short time, and it was not possible to obtain any accurate figures showing the power used by the motors under various conditions of speed and load. Formerly the machines were run by individual engines and much difficulty was experienced in starting them, as the pressure of the printing rolls against the cloth is so great. With electric motors this difficulty is overcome, as the motors will stand a very heavy overload for a short time, and the starting torque is very great. The great advantage of the electric system as here used is not so much in the saving of power as in the convenience to the workmen, and hence the increased production.

First Cost.—Practically the only objection which can be urged against the electric system is the fact that the first cost of installation is greater than with ordinary belting and shafting, but even this is questionable since the authors know of cases in which the estimated total cost of installing the necessary belting and shafting was actually greater than the equivalent electric motor outfit. The electric system would be cheaper for example in the case of very long or scattered buildings or those containing many stories or rooms, in any of which cases the belting and shafting required would be very complicated and expensive. The use of belting and shafting requires a much stronger and more expensive roof or ceiling than the electric system.

Saving of Power.—It might seem that the electric system would actually consume more power than the ordinary plan since it involves two transformations of energy. In most cases, however, if the power has to be distributed to a number of machines, particularly if they are located at any distance from the engine, the loss of power is less with electric transmission. This is explained by the high efficiency of the dynamo and motor compared with the low efficiency of belt transmission as ordinarily practiced, involving as it often does very imperfect alignment and lubrication of the shafting. Perhaps the greatest saving, however, of the electric system is due to the fact that the consumption of energy entirely ceases when the tool stops. This stoppage in the case of the busiest tools amounts to at least 25 per cent of the nominal working hours throughout the year and with large or special tools which are not used so steadily, the stoppage is often as high as 50 to 75 per cent since there are many whole days when they are not used at all.

Idleness due to strikes as well as to slack times must also be considered and would usually amount to quite a large percentage in ten years, for example. This assumes, of course, that a portion of the shop is running, which is usually the case even under such conditions. In short, with the mechanical system there is an enormous amount of shafting, idle pulleys and belting which runs for long periods of time doing little or no useful work, but consuming considerable power

Wherever electric motors can be substituted for a number of small engines scattered about, the saving in power is very great not only because of the low efficiency of small steam engines, but also by the avoidance of condensation in long steam pipes.

Increased output.—This is, perhaps, the most important advantage gained by the electric system, since after all the cost of power is a very small item, being, according to Mr. Richmond,[1] only about 1 per cent of the wages paid in average machine shop practice. This increased output is secured by the greater convenience and promptness in starting and stopping as well as in regulating the speed of the machinery. The workman can, for example, temporarily increase the speed when the conditions are favorable, thereby saving considerable time.

Flexibility.—The great convenience of moving the tools and placing them in any desired position is another great advantage of the new system. The great adaptability of this system is particularly well shown in the case of a factory which was almost completely destroyed by fire; nevertheless a few uninjured tools in a remote end of the building were operated successfully by means of electric motors within two days after the fire.

Speed Regulation.—The ordinary type of motor used in factories is the plain shunt wound machine fed with constant potential current. The motor is started and varied in speed by means of a rheostat in the armature circuit. This simple arrangement answers very well in most cases, but for variable speed between wide limits a serious wound motor controlled by a rheostat as in electric railway practice may be preferable. In other cases some special method of regulation such as the Leonard system, or the "boost and retard" plan, may be adopted.

The Montreal Meeting of the American Street Railway Association.

The officers of the association, with the executive committee, are at work upon the arrangements for the fourteenth annual meeting of the American Street Railway Association to be held in the city of Montreal, Canada, commencing Tuesday, Oct. 15, 1895, and lasting four days. It is proposed to make this one of the most successful conventions of the association. The exhibit of street railway apparatus and supplies will be made in the Victoria Rink, which has been secured for this purpose, being well adapted for such an exhibition. The exhibits of the American manufacturers and dealers will have to pass through the leading custom house when going, and upon the return through United States custom house. To facilitate their passage special arrangements have been made with Mr. M. Davis, customs broker, Montreal, for reduction in custom house charges on goods to be exhibited as follows:

Warehouse and Bond Entry..............	$1.00
Export and Bond Entry..................	1.00
Making and procuring Consular Certificates.	1.00

When goods to be returned are of the value of $50 or more, a consular certificate would have to be taken out, which costs $2.50; goods under the value of $50 require no consular certificate. The fee for the consular certificate is paid to the American consul and goes to his government, so that no reduction can me made in this. The fees, therefore, to be paid for goods under the value of $50 would be $2, and $3.50 would be added to that when a consular certificate is required.

Shippers should mark goods with their own name and "Care of M. Davis, Montreal, for exhibition purposes," prepaying the freight and sending invoices marked "Certified correct" and signed. On arrival, Mr. Davis will make warehouse bond entry, and have goods delivered at the Victoria Rink.

When the exhibition is over, the owners of the goods will have to repack them, using preferably the same cases that the goods came in, and they will be returned under the export bond. They must be careful not to make more packages of the goods in sending them out than they had in bringing them in, and it is a distinct advantage to have them in the same cases, so that the marks on these cases may be identified. Consignors must pay all freight and cartage.

Financial News.

Among the assignments of the month is that of the W. S. Hill Electric Co. of Boston, Mass., to F. A. Wyman. The company has done a large business, and the cause of the receivership is given as lack of sufficient capital and slowness of collections. The company has on hand a number of important contracts.

At a recent meeting of the Siemens & Halske Electric Co. of America, the number of directors was increased from five to nine and the following officers were elected: President, Augustine N. Wright; vice-president, C. E. Yerkes; treasurer, O. W. Mysenburg, and secretary, F. B. Badt. The recent increase in the capital stock of the company and the purchase of the extensive property of the Grant Locomotive Works has greatly increased the manufacturing facilities of the company.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

The Arc Lamp.

Long before the incandescent electric light had been invented, the arc light made by an electric arc formed between the ends of two carbon pencils, was used for illuminating purposes. At first a dynamo was used to run a single light, and such equipments were shown at the Centennial Exposition at Philadelphia in 1876. A few years later Mr. Brush had perfected a system of arc lighting by which a number of lights could be fed by one dynamo. These lights were run in series from a direct current dynamo. For several years arc lamps have also been run in multiple series on constant potential circuits and upon both direct and alternating current system.

The two pencils in the modern arc lamp are separated by a distance of from one-sixteenth to three-sixteenths of an inch. The electricity in overcoming the resistance of this air gap generates such an amount of heat that the tips are kept at a white glow. These tips are found to assume a particular form. The carbon toward the positive pole of the machine will be found to be cone-shaped with a depression at the top. This is the point of most intense brightness and the hottest. The other carbon will be found slightly rounded with a little pyramid just beneath the crater of the upper carbons. Under these conditions it will be noticed that the positive carbon, or one nearest the positive brush of the dynamo, will burn away much faster than the other, and because the greater amount of light is desired below the lamp the positive carbon is placed above the other.

In the alternating current arc lamp, since the current flows alternately in each direction, the carbons burn away with uniform rapidity and the ends assume about the same form. The light will be thrown up and then down as the direction of the current changes, and for this reason reflectors are placed above the arc to catch the upward rays. The light of the arc lamp approaches nearest to that of sunlight of any of the artificial lights used. It is used not only for the general purposes of illumination but also extensively in photography. The arc light per candle power is much cheaper than the incandescent light, but up to the present time the arc lamp has not been successfully made in as small units.

Resistance.

The term resistance may be defined in a number of ways according to the manner in which we desire to study the subject. If we study it from a practical standpoint, it is best defined as that attribute of matter by virtue of which it resists or opposes the passage of electricity. If it were not for the resistance of matter we could transmit electric power a thousand miles as easily as one, except that the expense of constructing the lines would be greater. The different kinds of matter resist or oppose the passage of electricity in different degrees. It is for this reason certain metals are so largely used in the construction of electrical apparatus and systems of distribution. Conductors of electricity are good or bad as they offer a less or greater resistance to the passage of electricity. Silver is taken as the standard with the percentage of 100 and the conductivity of all other metals is expressed in hundredths of the contivity of silver. Copper might well be called the electric metal since, on account of its low resistance and comparatively low cost, it is almost universally used in electrical work.

Bodies are therefore divided into two classes, conductors and non-conductors, or insulators. This division is, however, but a rough one, as there are many substances that are partial conductors of electricty. The metals conduct well, some substances conduct poorly and others not at all. The resistance of conductors of uniform cross section varies directly as the length. That is, if a conductor one foot long has a resistance of a certain amount a conductor of same material and same cross section two feet long will have twice the resistance; three times as long three times the resistance, etc. Another very important fact concerning the resistance of conductors is, that the resistance of conductors in general increases with the temperature. While this fact is true regarding metals, with nonmetals it is not true. The resistance of different metals does not increase in the same proportion. Iron at 100 degrees C, has lost 39 per cent of the conducting power it possessed at zero, while silver loses but 23 per cent.

When two or more metals are alloyed the resistance does not increase so rapidly with higher temperatures. Platinoid has a variation in its conducting power of but little over two per cent between zero and 100 degrees C. German silver, which is an alloy of copper, nickel and zinc, has a variation in its conducting power of about four and one-half per cent. For this reason the alloys are used in preference to the pure metals for resistance coils of rheostats and resistance boxes of all kinds. German silver or platinoids are the alloys generally used. Their resistance is not only more uniform under changes of temperature, but they do not oxidize readily and are consequently more durable. In conclusion, we may summarize the resistance of electrical conductors as follows: The resistance of a conductor is directly proportional to its length; indirectly proportional to its cross section and increases with the rise in temperature.

The Measurement of Resistance.

Since the resistance of no two metals is the same, it was necessary to select the resistance of some accurately defined substance as a standard of measurement. The unit adopted by the international electrical congress in 1893 and called the ohm, after the discoverer of what is called Ohm's law, is "the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14,4521 grammes in mass of a constant cross sectional area and of a length of 106.3 centimeters." From this is obtained the standard unit of resistance, but for practical purposes wires of known resistance or resistance coils are used.

These resistance coils require great accuracy in their measurement, in the insulation of the wire and in the mounting of the coils. The wires must be carefully selected and tested. The insulation must be such as will withstand the highest temperature to which it is subjected without change. Silk thread is extensively used for the insulation. The wire is usually wound on spools or in coils so as to occupy as little room as possible, and are mounted in a box, which protects them from injury and places them in convenient form to be carried. The ends of the coils are connected to plates or binding posts in the cover. This, also, must be carefully constructed so that the resistance at the point of contact will be as low as possible. A single coil is sometimes placed in an ebony case, or any number, according as the work for which it is to be used seems to require. When a large number is placed in one box the ends of the wires are usually connected to metal blocks, placed at such a distance apart that a metal plug will make a good connection between any two.

The resistance coils being uniform in size, the entire resistance or any part may be used. This is one of several styles of resistance boxes, which are manufactured by instrument makers, and is the one commonly used. In measuring the resistance of an electric circuit, we cannot take our standard of measurement as we would take a foot measure to obtain the length of a piece of timber, but we can use it in another way, which will be explained with the Wheatstone bridge. If that of which we wish tomeasure the resistance is carrying a current and we have a voltmeter and ammeter so we may obtain the difference of potential and amount of current, the resistance is easily obtained by means of Ohm's law, the resistance equaling the electromotive force divided by the current.

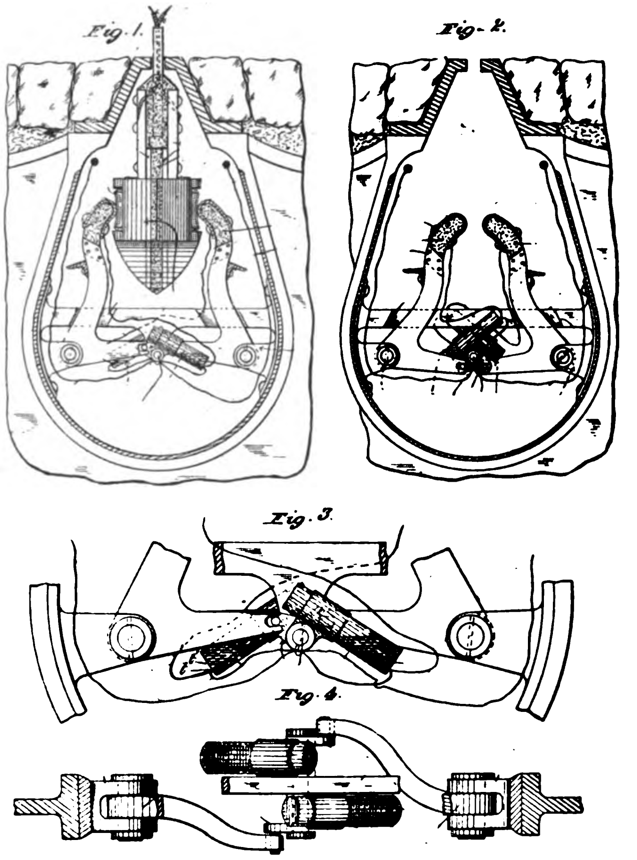
NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

The Cotton Conduit System for Electric Railways.

There was recently granted to Mr. W. H. Cotton of St. Louis, Mo., letters patent for a conduit system for electric railways. The system involves a number of new features which are outlined in the accompanying cuts. The motor car carries a collecting device underneath it, passing through a slot in the roof of the conduit. This collecting device is one of the features of the patent. It carries four rollers with insulated mountings, two on each side of the rod through which the conducting wires pass to the controller, and which also supports these wheels and mountings. A front view is shown in Fig. 1. The ends are pointed as shown in Fig. 5, which enables the carrier to enter between the successive contact rods without difficulty.

The feeders are carried through the conduit in such a way that taps can be taken off at frequent intervals to the contact sections. These are made in short lengths and each is insulated from every other. These sections are carried on brackets as shown in Figs. 1 and 2. These brackets are placed close enough together to support strongly the sections and are carefully insulated from it. The manner in which these brackets are flexibly supported is shown in Figs. 3 and 4. When the car is not over that section the brackets fall forward as in Fig. 2 but as the car comes along they are crowded apart as in Fig. 1.



FIGS. 1, 2, 3, AND 4.—THE COTTON CONDUCT SYSTEM FOR ELECTRIC RAILWAYS.

The connections from the feeders are not made directly to the contact bars but to a terminal in the receptacles attached to the lower arms of brackets supporting that bar. From another terminal in these recepticles an insulated wire leads to the bar. These recepticles are partly filled with mercury and when they are inclined the mercury covers both contacts. This occurs when the bars are forced apart by the collecting device as it enters a section; as it leaves it the bars fall forward and the circuit is again broken.

It will thus be seen that current is on the bar only while the car is passing it and is cut out immediately afterward. There is not opportunity for loss of current except when the car is moving, so for every car in operation there is but one live section. The collecting device has two parts insulated and connected separately to the controller. A complete circuit is thus provided and the ground return is not used. A most economical service is assured, as the circuit may be made with the lowest resistance and water and other pipes will not be injured by the return current.

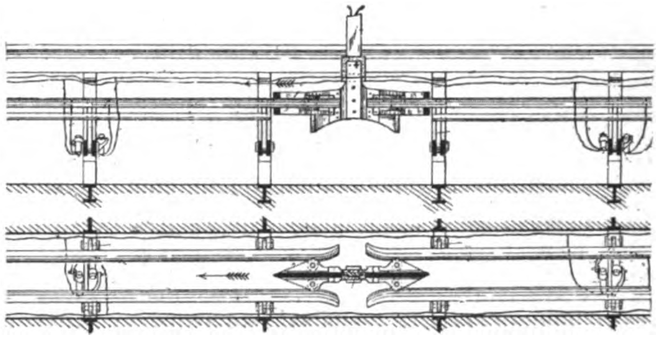
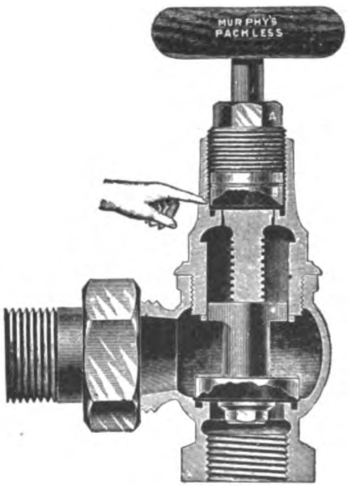


FIG. 5.—THE COTTON CONDUCT SYSTEM FOR ELECTRIC RAILWAYS.

The system has been ingeniously devised. An experimental line will show best its practical operation. The patent covers the current collecting device, the brackets with the recepticles sealed and containing the circuit completing mercury, the method of completing and opening the circuit and the many details of the system.

The methods of draining and cleaning the conduit are not shown in the drawings, since they are subordinate to the transmission and collection of the current. Such problems have been met in a satisfactory manner heretofore, and the usual methods employed may be used in this conduit. The exact form of the conduit may also be modified to meet the special conditions of particular cases.

Murphy's Packless Valves.



The radiator valve, shown by the accompanied cut, is being placed on the market by Mr. C. P. Monash, manager of the Van Auken Steam Specialty Co. of Chicago. The efficiency of this valve, we are informed, has been thoroughly tested by parties who are experts in the steam engineering line, and it has proven entirely satisfactory.

The improvement this particular valve possesses will be noticed by a glance at the accompanied cut. A lengthy description is therefore not necessary. The disc lettered "B" in the neck of the valve does the work. Saves the annoyance of escaping steam, water, air or gas, and is so guaranteed. The nut lettered "A" is used for adjusting the disc "B."

The value of a packless valve will best be comprehended and appreciated by the readers of this journal who have use for valves. They are being made for high and low pressure in globe, angle and straightway styles. The material and workmanship used in the construction of this valve is first-class in every respect.

A receiver was recently appointed for the Schuyler Electric Mfg. Co., of Hartford, Conn., in the person of Mr. Lewis Sperry.

Smith Electric Fans.

In the accompanying cuts are illustrated several styles of the Smith fans manufactured by the Huyett & Smith Mfg. Co. of Detroit, Mich. This company is one of the oldest manufacturers of fans and the styles illustrated will be found on inspection to possess many improved features. The fan shown in Fig. 1 is a Smith steel disc fan. The weak point in the ordinary fan is overcome in this fan by a patented feature. It is the large disc in the center.

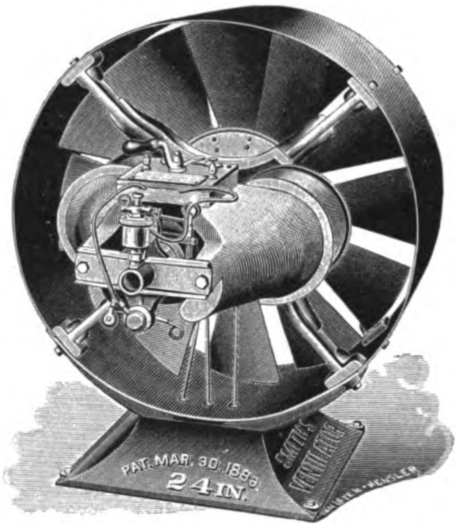


FIG. 1.—SMITH ELECTRIC FANS.

In all fans of this type the most powerful delivery is at the point farthest from the center. Right at the dead center there is, of course, no delivery whatever; consequently, any resistance to the flow of air causes a large volume of air to rush back at this ineffective point, unless some provision is made to hold it in check, which the disc does in the Smith fan. Having briefly referred to the merits of the fan, the motor that drives it is the next factor in consideration.

These motors are very superior machines, made to give the longest duration of service. Particular attention has been given to their mechanical construction as well as to their commercial electrical efficiency. They are made of the fewest possible parts and are simple and solid, built for hard work. The bearings are long and large, and are self-oiling and self-aligning. The commutator is composed of a large number of sections from the very best tempered copper and thoroughly insulated with mica. Every machine has carbon brushes, which are self-feeding and automatic in their action, requiring the minimum of attention. Every machine is carefully balanced. They are essentially a slow speed motor and give a uniform speed without noise or sparking, under varying loads. They will develop their full rated horse-power without undue heating of conductors or bearings, and they are tested under 25 per cent overload. The highest efficiency is obtained by care fully proportioning the armature with the field.

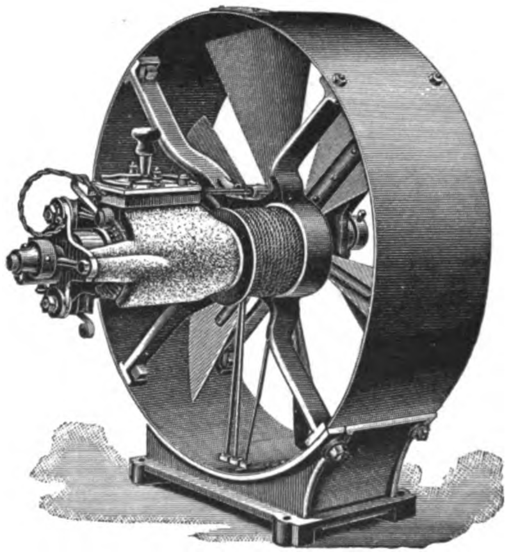


FIG. 2.—SMITH ELECTRIC FANS—THE CYCLONE.

The combination of the fan and motor has been ingeniously effected, each being adapted to the other. Great care has been taken to distribute the strength evenly, thus making a light and durable mechanism. The motor is supported by the frame of the fan, and the armature shaft being extended forms also the fan-shaft, thus combining both in one machine. It is needless to say this is a great advantage over ventilating fans run by belting, as it overcomes all obnoxious clicking and whirring noises.

The speed of the motor or fan is regulated by means of a three speed switch on the motor itself, thus doing away with all rheostats or resistance boxes of any kind and making it a most compact and efficient piece of ventilating machinery.

The manufacturers of this fan also build a cheaper fan called the Cyclone, shown in Fig. 2, which they claim close competition compelled them to build. To a great many nothing appeals but the price, and for just such people this fan is designed. It is not so powerful as the Smith fan, nor so heavy and strong in construction, but is built of first class material. The motor on this line of fans is of the same construction as on the other, only it is less powerful because the Cyclone fan does not handle so large a volume of air at the same speed as the Smith fan does.

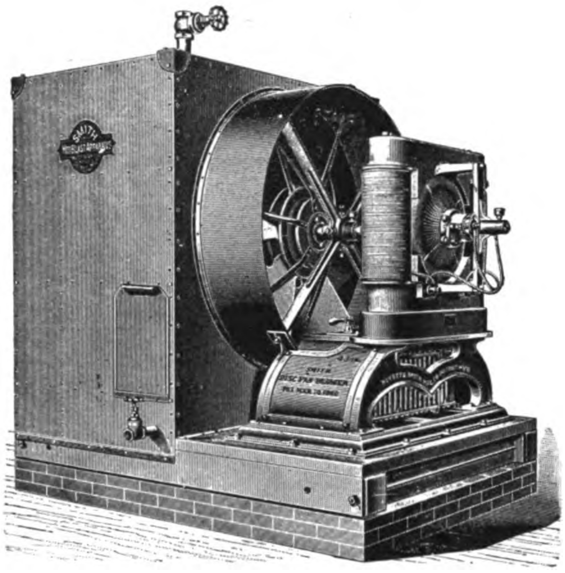


FIG. 3.—SMITH ELECTRIC FANS.

The maximum speed of either line of these fans does not exceed 1,100 revolutions for even the smallest size and from that down to 150 revolutions per minute. Fig. 3 shows the application of these fans and motors to the hot blast heating apparatus. The motor is of quite a different type from that used on ordinary ventilating fans. As will be seen, the motor is supported by a cast iron base, which also supports the fan, relieving the latter of all strain. This is a most complete mechanism for this class of work and has withal a very finished and handsome apparatus.

Self-Propelling Road Vehicles

On June 11th there was started a race between self-propelling vehicles at Paris for prizes ranging from $8,000 for the first prize through smaller amounts for the other prizes. There were more than one hundred vehicles entered for the race and a much smaller number took part in it. But one electrically propelled vehicle was entered and that did not appear on the day of the race. Less than thirty were actual competitors for the prizes. The course was from Paris to Bordeaux and return, a total distance of 727 miles, and the time made was two days and fifty-three minutes. The carriages winning prizes were all driven by petroleum motors.

A similar competition has been proposed by a Chicago newspaper to take place in November between Chicago and Milwaukee. The prizes offered are $2,000, $1,500, $1,000 and $500. It is to be hoped that some of the electrical carriages that have been seen at different times on the streets of Chicago will be modified to meet the conditions of this race and entered. The roads, however, are not so favorable as are those of France for storage batteries.

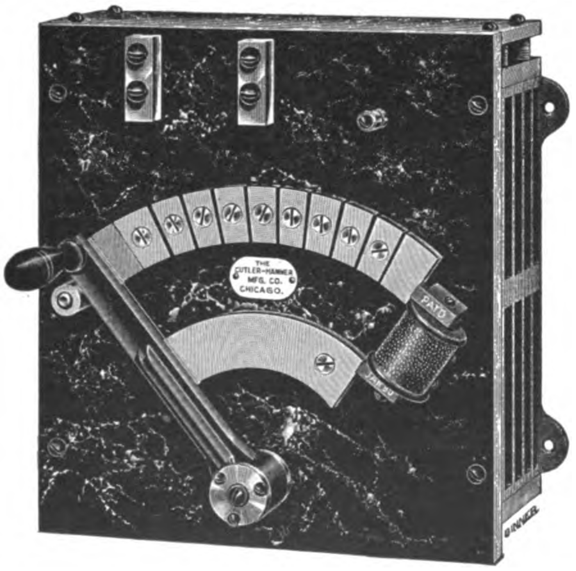
The Bryant Marine Switch.

In the usual description of a large electrical installation descriptions of the many smaller devices and appliances are necessarily omitted. Their description is left usually for a separate article. The accompanying cut shows a marine switch which has been used in a number of important installations on steamships recently fitted with electric plants. The main features of the switch are the same as those of the ordinary switches manufactured by the Bryant Electric Co., of Bridgeport, Conn., but for marine service strength and additional insulation were required.

The switch is placed in a metal box with the wires passing out through hard rubber bushings. The switch is mounted on a special porcelain base with large binding screws for the wire connections. A cover is fastened over the box, fitting tightly and protecting it from moisture or mechanical injury. The switch is adapted for all kinds of wiring on steamers for either ocean or lake service. It will also be found undoubtedly the proper switch for places where a strong and well protected switch is required.

Automatic Motor Starting Rheostats.

The automatic motor starting rheostat shown in the accompanying cut is manufactured by the Cutler-Hammer Mfg. Co., of 128-130 So. Clinton St., Chicago. It sometimes happens that the current is shut off at the central station, or the lines are cut. If the resistance is all out of the circuit when the current is again turned on, the effect on the armature is apt to be disastrous. This rheostat is so arranged that when the circuit is broken the little magnet which holds the lever in the "full on" position becomes demagnetized and allows the lever to fly back to the "full off" position. When the current is turned on the motor does not start until the attendant moves the lever starting the motor gradually.

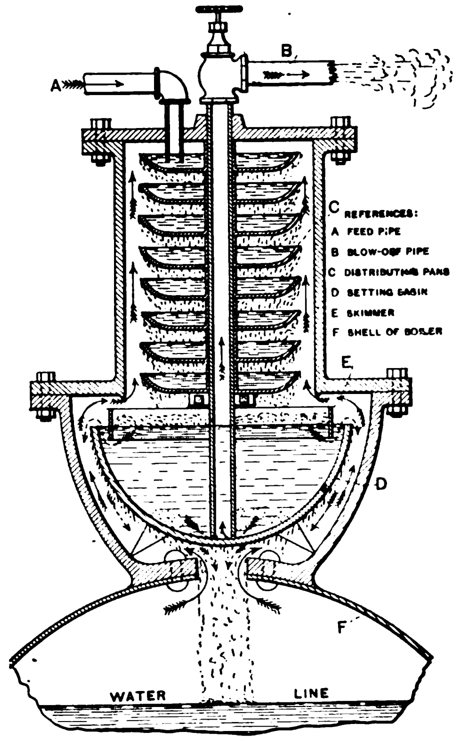


AUTOMATIC MOTOR STARTING RHEOSTATS.

The magnet is connected in series with the fields of the motor, and if the field circuit becomes broken the armature will be at once protected. The lever is provided with a spring in the hub, tending to keep the lever in the "full off" position. The rheostats are substantially constructed of fireproof material. The face is handsome marbleized slate. The contacts are large and well insulated. The design gives good ventilation and there is no overheating. The rheostat illustrated is made in sizes from one to fifteen horse-power. Four larger types from 15 to 200 horse-power are built. The design shown is the latest improved form made in these sizes. Every pains is taken by the manufacturers to produce an article that will be a credit to them. A high grade article will give perfect satisfaction and will outlast that which is more hastily constructed. The trade in this line of goods extends throughout North America and a trade has been established in Japan.

The Little Giant Feed-Water Heater.

The accompanying illustration shows a new device manufactured by Braucher Bros., of Danville, Ill., the inventors and patentees. It is a feed-water heater and purifier attached directly to the top shell of the boiler as shown in the cut. The live steam at full boiler pressure comes in direct contact with the feed-water as it enters this chamber from the feed pipe. The water flows downward over the pans, C, depositing its impurities on the pans, or they settle in the basin, D, from which they are blown off through the pipe, B.



THE LITTLE GIANT FEED-WATER HEATER.

The steam having access to the chamber at full boiler pressure will cause the water to be heated to temperature of boiling at that pressure. The steam in contact with the water gives up its heat and condenses, tending to reduce the boiler pressure. This is met by a greater evaporation of the boiler maintaining the boiler pressure. This enforced evaporation requires great quantities of heat, which will be taken at the most available point, that is the point of highest temperature, the heating surfaces of the boiler. The cold water does not come in contact with the tubes or the heating surfaces producing sudden changes of temperature, with their injurious effects on the metal, but as raised to the temperature of the water in the boiler before it enters the boiler. The impurities are also separated from the water and in this manner the efficiency of the boiler is increased and its life is prolonged.

Another death from electric shock is reported from Newark, N. J. An employe of the El. Light and Power Co. was found lying upon the floor of the dynamo room unconscious. Efforts were made to resuscitate him by the D'Arsoval method, but without avail. His hands were badly burned, showing that he had made a short circuit with his hands and received the full pressure of 3,000 volts. He was engaged in cleaning a generator but had failed to open the switch before commencing.

Electric Light Plant Steamer "Bay State."

Accompanying this is a cut illustrating the electric light plant on the new steamer "Bay State" of the Boston & Portland line recently installed by the Belknap Motor Company of Portland, Maine. The engines used are the "Ideal". The dynamos are multipolar slow speed machines of 400 lights' capacity each, but either machine will carry the entire load, amounting to 540 lights. It has become a general practice to use duplicate plants for marine work, so in case an accident should happen to either engine or dynamo the duplicate machine can do the work. The dynamos were designed by Mr. W. H. Chapman, electrician for the company. The plant does great credit to the company and has secured further orders for the installation of two direct coupled machines for the steamer "Portland" of the same line, also for the steamship "St. Croix" of the International Steamship Co., which is practically under the same board of management. The system of wiring is most excellent. There are eight main circuits controlled at the switchboard in dynamo room which lead to sixteen different distributing boxes, containing switches located in different parts of the boat, each switch controlling six lights, turning them on or off, as may be desired. These distributing boxes have glass fronts secured with lock and key and are under control of the steward of the boat. There are pilot lights on main and fore rigging and at the bows of the boat.

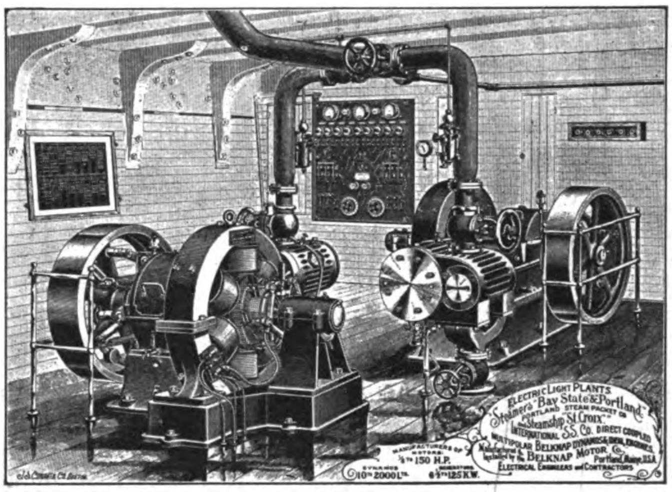

Electric Light Plants
Steamers "Bay State" & "Portland"
Portland Steam Packet Co
and Steamship "St Croix"
International S.S. Co. Direct Coupled
Multipolar Belknap Dynamos & Ideal Engines
Manufactured & Installed by the Belknap Motor Co.
Portland, Maine, U.S.A.
Electrical Engineers and Contractors
Manufacturers of Motors
⅛ to 150 H.P.
Dynamos
10 to 2000 Lts.
Generators
6½ to 125 K.W.

FIG. 1.—ELECTRIC LIGHT PLANT STEAMER "'BAY STATE."

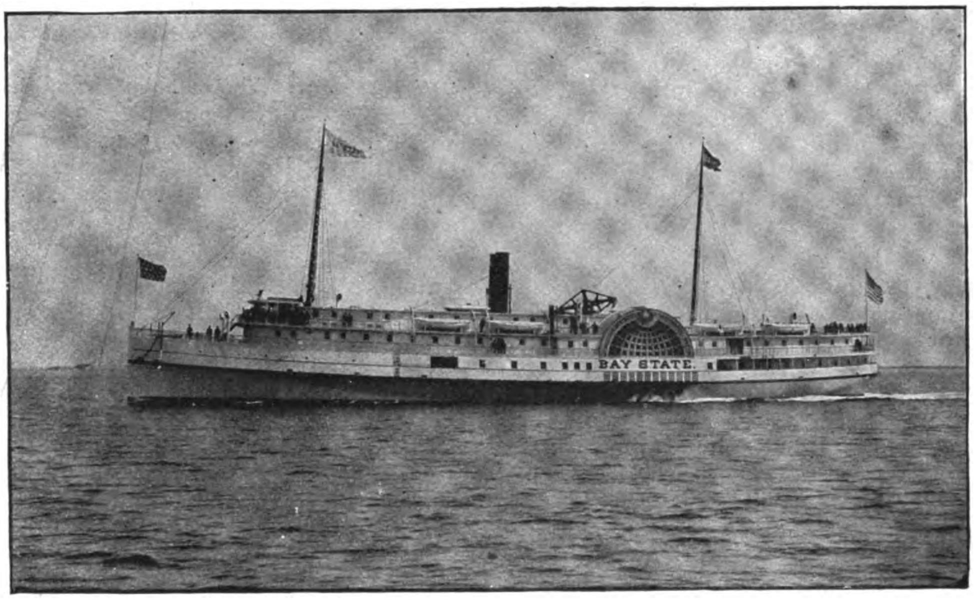


FIG. 2.—ELECTRIC LIGHT PLANT STEAMER ' BAY STATE."

The fixtures are of the latest design, with opalescent globes and shades. The dining saloon is fitted with ground glass globes, which gives this part of the boat a very cheery and pleasing effect. The freight deck lights are protected with guarded fixtures.

The boat at night presents a brilliant spectacle, being a veritable floating palace and surpassing in all its appointments anything that can be found in eastern waters, the sound lines alone excepted. The addition of this new boat has been the means of popularizing this line with the best class of the traveling public.

A Chemical Curiosity.

Among the various uses to which electricity has been put, since its cheap production by the modern "dynamo" has been secured, is the reduction of metallic ores or compounds is one or another form of the "electric furnace." The production of aluminum on a large commercial scale is the oldest and best known of these. There are, however, several cases in which the separation of the single element is not secured even in the electric furnace, but in which the element desired, while parting with its former companions, insists upon a substitute, and takes the same from the carbon electrodes or lining of the furnace, or from carbon mixed with it. This is the case in the manufacture of "carborundum," which is a compound of sillicon and carbon, formed by heating silica and carbon powder in an electric furnace. This compound has reached a large commercial application, by reason of its extreme hardness, which makes it a very superior substitute for emery or corundum, as a cutting and polishing material. The latest developments in this direction, however, is seen in the calcium carbide, which is prepared by heating in an electric furnace a mixture of lime and coal dust. The metallic calcium liberated by the action goes at once into combination with carbon to form a carbide, which is a mineral body of remarkable properties. In appearance, when in masses, it somewhat resembles the mineral serpentine, being of a greenish-gray color and crystalline fracture, with a luster like feldspar. If a few drops of water are thrown on this mass of seeming rock, gas is given off, which if ignited, burns with a brilliant flame; and, by continuing, from time to time, to sprinkle the rock with water, it will be made to blaze continuously as though it was being sprinkled with some very volatile and inflammable oil. If a fragment of the mineral is thrown into a glass of water, a rapid evolution of gas results, which may be ignited, and will continue to burn until the mineral is exhausted. The cause of these actions is that the calcium carbide in contact with water forms calcium oxide and acetylene gas, the oxygen of the water combining with the calcium to form calcic oxide, or lime, and the hydrogen of the water combining with the carbon to form acetylene. It is proposed to use this calcium carbide for local gas machines. A charge of the mineral is placed in a closed vessel into which a regulated supply of water is admitted. A little water entering forms a quantity of gas whose pressure shuts of the water; but, as the gas is used up, more water comes in to renew the supply. What may be the commercial value of this material we are not prepared to say, but it is certainly a great chemical curiosity.—Stevens Indicator.

In the suit of the Brush Electric Co. vs. the Western Electric Co., for infringement of the Brush double carbon lamp patent, in the United States Circuit Court at Chicago, July 24, Judge Showalter decided that there was no infringement in the Western Electric Co.'s double carbon lamp. The decision is quite the opposite of previous decisions regarding this patent aud puts an entirely different construction on the grounds covered by this patent.

ELECTRICAL CATECHISM

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[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

[COMMENCED IN NO. 2, VOL. VI.]

83. *Can any interesting experiments be made with a condenser or Leyden jar?*

One can get or give shocks by them; make a person see stars; kill flies or rats; pierce holes in cardboard or even in glass; make lightning and thunder on a small scale; set fire to gas or alcohol; get pretty luminous effects. Other experiments will suggest themselves to the observant student.

84. *How can a condenser be used to give a shock?*

One method was suggested in No. 77. A favorite joke in electric light stations is to charge, or "load," an incandescent lamp by holding it near a belt, and then to hand it to some unsuspecting person; or if the room is very dry leave it in some convenient place for curious persons to examine.

85. *Is it possible to kill rats or flies by the spark from a belt?*

They can be given shocks that will greatly surprise, and sometimes stun or even kill them. Arrange two strips of metal side by side and well insulated from one another, as suggested in Fig. 19. Dry wood will insulate well enough. Connect one strip to a spark collector such as a brush or wire near the belt, and connect the other end with the water pipe or other good ground. When any animal crosses from one to the other in such a way as to touch both metal strips at once he will regret it. A similar plan may be arranged to prevent people from committing nuisance. In some cases, butchers and candy merchants have, in a similar way, reminded meddlesome persons from handling their meat or other wares.

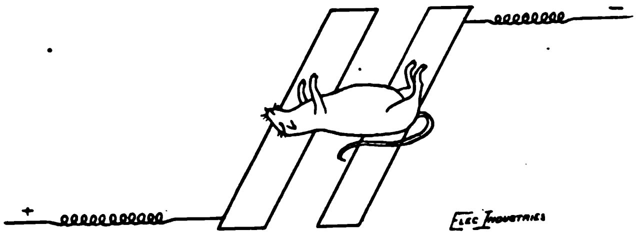

FIG. 19.

86. *How can one see stars by electricity?*

A drinking glass with metal case such as used at soda fountains, makes a condenser that may be loaded easily as suggested in No. 77, the liquid and the metallic holder being the two surfaces. After the cup is charged (not too strongly for fear of injuring the victim), hand it to a friend to drink. He will see stars and will endeavor to share the sensation with the perpetrator of the joke. One can also see stars by the help of an incandescent lamp. Charge a lamp feebly by holding the bulb in the hand and bringing the lamp base near a belt for a short time, being careful not to charge it too strongly; then touch the lamp base to the forehead. One will seem to see a flash of light although the eyes are tightly closed. The electricity passing between the forehead and hands affects the optic nerve in about the same way as light affects it.

87. *How can luminous effects be produced by a condenser or by static electricity?*

An incandescent lamp—one with a broken filament is as good as any—will become luminous if held in the hand and brought near the belt. Pretty effects are obtained by moving the fingers to different parts of the bulb. For some time after the bulb has been charged, it may be made to glow by simply rubbing with the hand. These effects are much prettier in a dark room. Sometimes when the lamp is highly charged, sparks will pass along the surface of the glass or will seem to jump through it and will give one quite a hard shock.

88. *What is a Geisler tube?*

This is a glass tube containing two platinum wire terminals passing through the glass and having the air exhausted so as to leave a partial vacuum. Electric discharges or sparks pass between the two wires much more easily in a vacuum than in ordinary air. The passage of the discharge causes the air or other gas to become dimly luminous. The color of the light depends upon the kind of glass and upon the gas enclosed. Geisler tubes are sometimes made in beautiful designs. A incandescent lamp is the most common form of Geisler tube.

89. *Can Geisler tubes be used for lighting purposes?*

Until recently the Geisler tube has been principally an interesting, scientific toy, but for several years past a number of investigator have been trying to put it into shape for lighting purposes. The Geisler tube is the most efficient source of artificial light that is known, that is, a larger proportion of the total energy delivered to it is changed into light than by any other known means. But the light from such tubes is always very small and hence is not suitable for general illumination. Tesla and others have done much work along this line and it is one of the most promising fields of electrical research.

90. *How can lightning and thunder be produced artificially?*

The crackling sound heard when a spark passes is really thunder on a small scale and the spark is minature lightning. The noise is caused by the sudden heating and cooling of the air by the spark. The larger the condenser and the higher the potential, the louder will be the sound.

91. *How can the spark be made to pierce holes in cardboard or glass?*

Paper or cardboard can be pierced by connecting the two terminals of a charged condenser to two points directly opposite each other and separated only by the paper. In passing between the two points, the sparks make small holes in the paper or cardboard. By having a condenser sufficiently large and charged to a very high potential, such as may be obtained by a large static machine, one may pierce holes through glass. The apparatus in some of the Universities will pierce glass one-quarter inch thick By examining carefully the appearance of the hole through paper, cardboard or glass to discover the direction in which the spark passed, one sees that the spark seemed to go in both directions or to start in the middle. The evidence of extended experiments with more complicated apparatus confirms the belief that the spark really consists of a number of sparks going first in one direction and then in the other; in other words, the discharge of a condenser is often oscillatory, the spark passing back and forth like the swinging of a pendulum. Careful study of experiments along this line has led scientists to believe that lightning discharges are generally oscillatory, and the most efficient lightning arresters are made upon that idea. Further reasoning from this point strengthens the theory and belief that electricty itself is a vibratory motion and almost if not quite identical with light.

92. *How can alcohol be set afire by a spark?*

Put the alcohol in a dish in which a wire or other conductor is placed so that the end is at or just below the surface of the alcohol. Connect the further end of the wire to one terminal of the charged condenser and bring the other terminal near so that a spark will pass to the point in the alcohol. The spark at the surface or the alcohol and air will set it afire. Cigar lighters are sometimes made upon this principle, the spark being produced by a frictional machine or by an induction coil.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—ED.]

WIRING FIRE PROOF BUILDINGS.

I am a subscriber to your paper and would like to have a little information through your columns in regard to the wiring for incandescent lighting. How are fire proof buildings wired where all walls, ceilings, etc., are tile and steel? How are the wires held in position or fastened to the walls? Hope some one will give us this information.

CAMBRIDGE, ILL. G. L.

FIXTURE HANGING.

What is the best method of hanging electrical fixtures when there are no gas pipes in the building? I have been using hooks in frame buildings and have been getting fixtures with a cap and eye on. This is very satisfactory as a general thing but the beams don't always come just where you want your fixture and it is a considerable trouble to get a substantial support for the electrolier, especially if it is large and heavy. What is the practice where Underwriters' rules are not followed regarding fuse blocks for every fixture? Is not a single fuse for eight or ten lights sufficient protection? Is rubber insulated wire necessary or will cord answer as well?

ROMONA. D. C. S.

A SHORT CIRCUIT ON A SWITCHBOARD.

A rather peculiar incident happened at our station the other evening. It may have occurred to others, but this is the first time in my experience. We recently had a new panel put in our switchboard to replace a broken one, taking the instruments from the old panel and putting them on the new. The leads from a 1,040 volt alternator lead to this panel. When it was in place I noticed in the marble a number of brown viens, like the roots of a plant running through it. A few nights later as I was standing by one of the machines I saw as nice a little piece of fireworks as was ever used to celebrate the Fourth of July. There was an extra buzz to the machine and then all subsided, running again as before. I stepped to the board and found a black, charred line where the current had followed one of the brown veins. Nothing of the kind has occurred since and so I suppose the short circuit, which was maintained but for an instant, destroyed the conducting material.

SANDSTONE. J. L. F.

BURNING OUT OF ARMATURE.

I am frequently asked the question what makes the armature burn out. I hear it most frequently when I am telling a customer that the expense of producing his light is not the interest on the investment entirely but for coal for generating steam, replacing an armature when one burns out, etc. The armatures of motors on our lines have several times burned out, from what cause no one knows. The customers using the motor knew nothing about it until it refused to work. I have thought of the matter considerably and do not see why an armature, if well constructed, should burn out under ordinary service. The effects of lightning, of course, cannot entirely be guarded against. I believe that in many instances the insulation of wires deteriorate until finally under an extra heavy load it gives way entirely. Such a load may be placed on a motor that the wires will become almost red hot, but in driving such machines as are operated from our circuits I do not believe it occurs. Carelessness in starting and stopping the motor or leaving the armature circuit with resistance out, so that when the switch is closed a free path is left for the current hrough the armature, damage the insulation. There must also be something in the construction of the armature, for a customer has two motors which have been running side by side. They are the same size, make, etc. They are each seven years old. One is just as it was put in, but the other one has been rewound twice. What the difference is between the two machines, perhaps, no one could tell, but no cause has been discovered why the armatures of one machine should burn out and that of the other remain perfect. I believe in the insulation of electric wires a great improvement will be made. In the larger dynamos great improvements have been made in the insulation and mechanical construction such as are not possible in the smaller drum armatures.

PARKERVILLE. L. E. M.

DYNAMO FOUNDATIONS.

Good foundations are necessary for both engine and dynamos, but it is not necessary, it seems to me, to put too much money into this part of your plant. If the foundation is able to sustain the weight of the machine and is built of such material as not to crumble with age and the effects of its load, I have always maintained that it answers its purpose. It is not an easy matter always to estimate the required strength, but I do not believe in putting so much money into foundations as I have seen many builders do. When I have wanted an extra good foundation I have proceeded very much as I would for the walls of my building. I made an excavation deep enough to get below the loose surface earth and put in a concrete bottom. The thickness of the concrete I regulate according to the kind of soil. If light and fine I make the concrete thicker than in gravel or clay. Upon this I put the brick, laid in cement to reach the height of the machine, putting in anchor bolts to secure the stone cap and engine, or insulating block if a dynamo. I no not consider the stone cap necessary, but it makes a strong bed for the machine and gives the most permanent construction. Under dynamos I consider a wooden insulating block essential and would have it of a sufficient thickness to hold the lag screws with which the sliding rails are fastened down. When built up in this manner a substanial construction is secured throughout. The foundations should always be brought up level and the machines will run with less friction. Careful attention to this point will save many dollars every year. The foundations should also be built up after the position of the machines has been accurately determined. I have seen foundations put in in such an irregular way that when the machines were lined up, one of them was so far out of the way that an addition had to be built on one side. The sides of the bases were not parallel with the sides of the foundations and the plant was always an "eyesore." If the foundations are accurately laid out you save in both material, labor and expenses of setting machines. By proportioning the cement and sand used the expense may also be lowered providing good material is used, but care should be taken to have the mixing well done. If you have soft or broken brick use them somewhere else. Don't put them under your machines. D. E. F.

CINCINNATI.

COST OF AN EFFICIENT INCANDESCENT LAMP.

Incandescent lamps are quoted to me all the way from 17 to 26 cents each. What am I to expect from the 17 cent lamp, and what from the 22 cent or the 26 cent lamp? I should like to buy lamps as cheaply as possible but can't tell which is the cheapest without trying them all. It seems to me that the lamps I used to pay 65 cents for were as good as any I get now-a-days, if not better. Are the lampmakers simply trying to lower the price or are there lamps on the market that will show as good or better efficiency than those of eight or ten years ago? I have been paying 22 cents for sometime now, thinking that was as low as a good lamp could be made for and inspected with reasonable care before being shipped. Could not incandescent lamps be graded like other commodities from fixed standards so that the purchaser would know what he was buying? From the appearance of a lamp no one can tell what it will do and poor lamps can easily be sold for high grade lamps because the purchaser is unable to tell the

quality of his purchase until he has tried them. If 17 cent lamps are fourth grade lamps they should be sold for what they are and not for high grade. Simon L.

PERSONAL.

Mr. Charles Wirt is now located at Ludlow and 31st streets, Philadelphia.

Mr. Jas. T. Haubay has been appointed general manager of the Beacon Lamp Company, Boston.

Mr. W. P. Sullivan has been appointed western manager of The Electrical Engineer, at Chicago.

Mr. Edwin R. Reynolds, of Milwaukee, has received the degree LL.D. from the University of Wisconsin.

Mr. C. O. Baker, jr., well known to the electric lighting fraternity, returned the first of the month from a European trip.

Mr. E. L. Barr has been appointed secretary of the Wallace Electric Co., to fill the vacancy made by the resignation of Mr. Max A. Berg.

Mr Wm. H Pike, jr., so long connected with the Brady Mfg. Co., and for the last two years as their superintendent, has resigned, and is now taking a much needed rest.

Mr. Frederick E. Bruce, recently manager of the Stirling Company at Cleveland, has taken charge of the New York office at 74 Cortlandt St. of the National Water Tube Boiler Co., of New Brunswick, N. J.

Mr. James Boyd, associate editor of the Street Railway Review, was married on July 9 to Miss Mabel Katherine Peck at the residence of the bride's parents, Chicago. After an eastern trip the couple will take up their residence in Chicago. Electrical Industries extends congratulation.

Mr. Oluf Tyberg, M. E., so long and favorably known as a practical and theoretical engineer and as the designer of many automatic and other labor saving machines, has recently acquired an interest in and accepted the position of superintendent of the Brady Mfg. Co., of 83 Washington St., Brooklyn, N. Y.

Mr. A. L. Reinmann has accepted the position of superintendent of the American Electric Manufacturing Co. of St. Louis. Mr. Reinmann has long been connected with the manufacture of electrical goods. He was superintendent of the Westinghouse lamp factory and later of the Sawyer-Mann factory in New York.

Mr. W. B. Ball, of the firm of Ball & Allen, consulting electrical and mechanical engineers, 1625 Monadnock Block, returned last month from Amherst College, where he has been pursuing the past year a post-graduate course. The special studies he has taken will add greatly to his previous experience and knowledge of engineering.

NEW BOOKS.

"Transactions of the American Institute of Electrical Engineers," Vol. XI., published by the institute at 26 Cortlandt St., New York City, 1894. Annual subscription, $5.00.

The transactions of the American Institute of E'ectrical Engineers are distributed to members and subscribers in monthly parts during the year, being intended for simply the use of the readers. The papers and discussions are afterwards revised and the folios arranged for the annual volume to be issued at the end of the year. The index is made for the bound volume and for permanent record the bound volume is the best in every respect. The volume for 1894 is well printed with matter neatly arranged, and contains also a list of members with their addresses.

Municipal Ownership: Its Fallacy. With Legal and Editorial Opinions, Tables and Cost of Lights as furnished by Private Companies and Municipal Plants. By M. J. Francisco. 1895. Fourth edition revised. Ruthland, Vt. Published by the author. 100 pages.

Few men have made so careful a study of the municipal ownership of electric lighting plants as Mr. Francisco, who, through an extended experience in the management of electric lighting central stations, has gained a thorough knowledge of the practical side of the subject. He is thus able to point out many of the fallacies of municipal ownership. Numerous examples of unsuccessful municipal enterprises are cited, showing the absence of economical management and pointing out the uselessness of engaging in pursuits other than those for which the public organization was created. The opinions of many well-known men are given on this subject. The statistics and figures taken from the actual records of the plants are the most convincing. In parallel columns are placed lists of municipal and private plants in the same locality with the cost per candle-power hour and the number of candle-power hours received for one cent. The conclusion at once drawn indicates that the public can purchase its light cheaper than the city can produce it. A list of municipal plants is also given with notes describing the cost of installation, size and various other facts regarding them. The book might well be studied by city councils contemplating the establishment of a public central station. It shows the faults in many existing plants. This volume will interest all to whom the subject of municipal ownership has been presented. While it presents but one side of the subject, and whether that side be right or wrong it is well to know it. The bright, enthusiastic pictures painted of municipal plants wou'd lose some of their brightness if painted with colors from this book.

The New Works of the Westinghouse Electric and Manufacturing Company.

In the annual report of the directors of the Westinghouse company to the stockholders the improvements in the manufacturing facilities of the company made during the year are thus described:

The all-important feature of the year's business has been the creation of a magnificent workshop, having unequaled facilities for the carrying on of the business in which your company is engaged, and the concentration therein of the manufacturing operations formerly conducted under great difficulty in three widely separated works, with material stored in numerous warehouses.

These new works, located at East Pittsburg, about twelve miles east of Pittsburg, are extensive and exceptional'y complete in every detail necessary to the production of the best class of apparatus at the lowest possible cost, and will thus insure to your company many advantages. These new works were erected during a period of exceptionally low prices for labor and material, and under other favorable circumstances, so that the cost shown in the accompanying balance sheet is greatly below earlier or present prices for like work.

As was to be expected, such extensive building operations and the removal of materials from the old to the new works reduced the output for the year to about three quarters of what it would have been without the interruption and extra work entailed.

The annual meeting of the stockholders of the company was adjourned at the regular date (May 15) to July 17, as the transfer from the old to the new works had not at the earlier day been fully effected, it having proved far more difficult and complicated than your directors had anticipated. They are glad to be able to announce that it is now completed, with results which promise to be most satisfactory in the immediate future of the company. It was the desire of the board that at the annual meeting every opportunity be afforded the stockholders to see for themselves what had been accomplished, and so form their own opinions of the efficiency of the plant and the value of the property. This was not possible in May: it is possible now. The directors therefore earnestly invite all holders of the company's stock, who may be able and desire so to do, to attend in person the annual meeting, on July 17, at Pittsburg, where special railway and other arrangements will be made. Meanwhile, the directors feel justified in saying that the works are as nearly perfect as they could now be made and are now operating to the entire satisfaction of those in charge, and that the production has already been increased to a point where the demands of all customers can be promptly met, and there now seems to be no reason why your company should not in the near future be as large a producer of electrical machinery as there is in the country.

In anticipation of the increased facilities which your company would have in its new shops, a large amount of time and energy was put into the development of new and better forms of apparatus for the trade, and this extra work together with that incident to the preparations necessary to occupy the new quarters increased the general and extra expenses to a figure somewhat above that for the year ending March 31, 1894.

So far as ascertained there was expended directly in removing the machinery and material $90,499.54, after deducting which from the earnings from business and from other sources, there is left a net profit of $711,909.68.

This, also, it must be borne in mind, was the outcome of a business year during which, for reasons already stated, your company was working under conditions as to output which, in the opinion of your directors, were so unfavorable that the net results scarcely represent half of what might reasonably have been expected under ordinary circumstances.

CAPACITY OF NEW WORKS.

Our present room is sufficient for the employment of between four and five thousand men. The various buildings have been so arranged that the main workshop can be readily extended and the capacity of the works doubled at a comparatively small outlay without interference with regular manufacturing during building operations. Outside of the main buildings the others already have the required capacity and there is still available for further buildings fully one-half of the forty acres owned by the company.

The indications are that the demand for electrical apparatus in general will be greater during the next twelve months than for any like period in the past, and it is therefore a matter of great importance that our new works are now in complete operation.

TRADE PUBLICATIONS.

No. 1, Vol. 1, of "The New Galaxy," recently appeared, published by Harry C. Jones, 93 Fifth Ave., New York. It is a popular magazine, profusely illustrated, and contains well selected articles from well-known authors. The illustrations are not confined entirely to half-tones, but large numbers of pen and ink drawings are used.

A small catalogue on the little giant feed water heater and purifier manufactured by Braucher Bros., Danville, Ill., will be found of interest to engineers and steam users in general The facts regarding this heater are plainly stated, together with various facts regarding the economical generation of steam. The pamphlet is in very convenient form and tastily gotten up.

"Shipping and Commercial List and New York Price Current" contains in recent issues articles of a historic nature on the commerce of New York. These articles are very interesting to the young, and to the older business men bring to mind many interesting facts in their business career. This publication is the oldest commercial paper in America, celebrating this year its one hundredth anniversary.

The Electrical Journal, edited by F. A. C. Perrine and Geo. P. Lowe, and published at San Francisco, appeared for the first time July 1. It is claimed to be the newest electrical publication in America, which is certainly well founded. The publication is neat and attractive in appearance and its reading pages contain much that is of interest. The editors are both well known to the electrical fraternity.

The proceedings of the third annual convention of the Northwestern Electrical Association were recently received. An excellent portrait of the late president of the association, Mr. H. C. Thom, is placed opposite the title page. Besides the proceedings of the association, it contains lists of officers and members of the association. The contents give evidence of careful work in compiling the proceedings and in the production of the pamphlet.

Cassier's Magazine for July is devoted entirely to Niagara and its wonderful power plant. It is a magnificent production and is certainly one of the finest numbers ever gotten out. The articles are written by prominent officers of the companies interested and by well-known engineers connected with the carrying out of this great project. The illustrations, finely executed, are brought out in every detail upon the superior quality of paper used. It is an excellent souvenir of the opening of this great power plant.

The constitution and by-laws of the Texas Gas & Electric Light Association, with a list of officers and members, has been received. The appearance of this pamphlet shows that the association, although but recently organized, is a permanent thing and is proceeding in a thoroughly business-like manner. The officers of the association are well-known business men, and the association will undoubtly have a lasting influence in the industries it represents in Texas. The constitution differs little from that of similar organizations, but is brief and well written.

The De la Vergne Refrigerating Machine Co., East 138th St., New York, is now placing upon the American market the Hornsby-Akroyd patent safety oil machine A special department, under the management of Mr. George Richmond, has been created for introducing this engine. This oil engine has an established reputation in Europe, where it has taken many prizes at various expositions in the different countries. The oil and gas engines are making great advancement in this country, and the above company will undoubtedly be very successful in handling this engine.

The new catalogue of the National Electric Manufacturing Co., of Milford, Conn., is one of the handsomest catalogues recently received. The National company is the successor to the Electrical Department New Haven Clock Co, the Microphone Carbon Battery Co., the Porter Electric Messenger Co, and the Splitdorf Wire Co., and the well-known apparatus and specialties of these companies, together with many new ones, are listed. The company is the manufacturer and dealer in electrical apparatus of every description, and the catalogue shows a great variety of electrical appliances and supplies By the insertion of plates, printed with colored ink, special prominence is given to the fire alarm apparatus manufactured. The cover is well designed, the contents are neatly arranged and nicely printed.

The chloride accumulator is described and illustrated in a recent catalogue issued by the manufacturers, the Electric Storage Battery Co., of Philadelphia. The contents describe the construction of the storage battery, its capacity, durability, internal resistance, etc, and also describes numerous central station plants using such accumulators. Accumulators in isolated plants for traction work and for various purposes are also treated. Sizes, prices, instructions for installing and reports of tests are some of the items it contains. It contains also much instructive matter as well as information regarding prices, etc.

The Hogan Boiler Co. of Middletown, N. Y., has issued a pamphlet entitled "Truths." These truths, it is needless to say, relate to the Hogan standard water tube boiler. They are very nicely arranged in short paragraphs, which forcibly set forth the important facts regarding these boilers. One of the excellent features is the concise but brief manner in which the various truths are handled. The reader is not burdened with long descriptions and tiresome arguments. The facts are presented and the reader can make his own comparisons. Several tables of important information, with detail drawings of the boiler, are given.

A recent catalogue of the Belknap Motor Co., of Portland, Me., describes the different types of electrical apparatus manufactured, and also many plants where it is being used. This company is now well known to users of such apparatus and its dynamos and motors are being used in all parts of the country. The illustrations and descriptive matter set forth in an excellent manner the various details of the electrical apparatus. The pamphlet also contains a list of some of the users of the B. C. standard dynamos and motors, together with numerous testimonials and wiring tables, especially valuable in the installation of such apparatus.

BUSINESS NOTES.

QUEEN & Co., Philadelphia, has secured the right to the Wirt switchboard instruments and will conduct their manufacture hereafter.

THE BULLARD ELECTRIC Co., Chicago, is one of the latest companies to enter the manufacturing field. The company will manufacture electrical apparatus.

MR. STANLEY GREEN, western manager of the Fuel Economizer Co., of Matteawan, N. Y., sold recently to the Tuttle Mfg. & Supply Co., Anaconda, Mont., 2,500-horse power of economizers.

AMERICAN CARBON Co. has removed its offices to Noblesville, Ind., where its factory is located. The change places the offices and works together, enabling the business to be conducted under the supervision of the officers of the company.

GEO. S. SEARING, western representative of the National Electric Manufacturing Co., is meeting with success in the distribution of the well-known products of the above company in connection with other specialties for which he is the western agent.

MR. JAMES WOLFF, Chicago, sales agent of the New York Insulated Wire Co., reports a number of recent orders for "Grimshaw" and "Raven Core." His hustling qualities were not lessened by his heavy duties as a member of the entertainment committee during the recent convention.

THE MICHIGAN ELECTRIC Co., Detroit, Mich., has recently received the agency for the state of Michigan for the machinery and supplies of the General Electric Co The company has grown rapidly since its organization a little over two years ago, and now enters more aggressively the electrical field.

MR. HARRY M. SHAW, 126 Liberty St., New York, represents the H. T. Paiste Co, of Philadelphia, in New York, and a full line of the Paiste specialties are carried. The non-arcing lightning arresters placed on the market by Mr. Shaw are being well received by railway and central station men. Eureka batteries, commutators, segments, brushes, etc., are carried in stock.

MR. T. W. SHELTON, St Louis, Mo., is placing before the trade a type of rheostat invented by him, which possesses a number of valuable features. A few reasons for its superiority are set forth in a recent circular as follows: Simplicity of construction, durability, unaffected by moisture, adapted to any type of motor or dynamo, and can be placed in any position. It is now in use on several electric railways.

THE HART & HEGEMAN MFG. Co, Hartford, Conn., has its well-known line of switches well established among the dealers in electrical supplies. Hart switches, both single and double pole, are being used in electrical installations in every part of the country. Mr. Geo. S. Searing, the western representive of the company attended, the recent convention of the Northwestern Electrical Association in the interest of these goods.

THE CUTLER-HAMMER MFG. Co., 128-130 S. Clinton St., reports a complete recovery from the disastrous fire which destroyed the factory in March, and that the business during the past two months has been the largest in the history of the company. The full force of employes is working overtime to keep up with orders. Among the regular customers of the company are some of the largest manufacturing companies in the United States, and their goods go to every State in the Union, to Mexico, Canada and Japan.

The Chas. E. Gregory Co., Chicago, reports that businss in general is especially good. During the month of July the company sold 23 dynamos. which is evidence of improved business conditions.

The Western Telephone Construction Co., Monadnock Block, Chicago, has been awarded the contract for the telephone system on the Metropolitan West Side Elevated Railroad at Chicago. Many other contracts have recently been booked by this enterprising company.

Grier Bros., western representatives of the Bryant Electric Co., and R. Thomas Son's Company, have been very successful in keeping their well-known specialties before the trade. Probably no one is better known among the trade than the gentlemen composing this firm. having been for years closely associated with electrical interests. At the recent convention of the Northwestern Association both were present in the interest of the companies they represent.

The A. W. Harris Oil Co., Providence, R. I., manufacturers of valve oil and engine oil, has recently opened a western office at 1325 Monadnock Block, Chicago. The office is under the management of Mr. Urban W. Frink, who is well known to the electrical fraternity of that territory. The establishment of this office has been found necessary to take care of the extensive business done in this territory. Electrical stations and power plants use a large amount of the oils of this company.

The Metropolitan Electric Co., 186 and 188 Fifth Ave., Chicago, reports that the season's business in the fan motor line has been most excellent. The Metropolitan incandescent lamp has been in large demand and preparations are being made for a heavy fall trade. In the line of railway and central station supplies the trade has constantly increased. The company entertained at its salesroom many of the visitors at the recent convention of the Northwestern Electrical Association.

The Electric Appliance Co., 242 Madison St., Chicago, is just announcing their acceptance of the general western agency for the American Flag dry battery. The claims made for this battery as an open circuit battery are for its superiority in the volume of current and durability. It is offered particularly for telephone work, for which it is especially adapted. It is made in three sizes for different kinds of service thus filling the demand for a small pony battery or for a cell of large volume. In the line of supplies and Paranite wire the company reports a heavy trade. A most attractive exhibit was made at a recent convention and the company was well represented during the proceedings.

Mr. C. P. Monash, of the Van Auken Steam Specialty Co., recently received the following communication from Prof. L. P. Breckenridge, of the University of Illinois, which speaks well for the Murphy Packless valve: "Answering your communication of May 20, concerning the Murphy Packless Radiator valve, I am glad to say that the valves which we have had on the first floor of our new Engineering Building at the university have given us entire satisfaction, and I have not been able to discover any one who has known of their leaking at any time during the past year. It seems to me that the Murphy valve is a practical invention, and it is bound to succeed as soon as its superiority is recognized."

The Bryan-Marsh Company, 136 Liberty St., New York, has reason to feel proud of its "Imperial" brand of incandescent lamps from the test recently made by Mr. Charles T. Stillwell. The Imperial was placed in direct competition with a number of imported lamps, and all were tested for the purpose of ascertaining the best practical lamp for commercial usage. Mr. Stillwell's decision was governed solely by the consideration of highest excellence irrespective of initial cost and was awarded to the Imperial. Mr. Stillwell is a pioneer in the industry and knows incandescent lamps from a to z. He wished to select the best lamp for his Canadian customers, but further than that he was uninterested. The tests were thorough from every point of view.

The Ball Engine Co., Erie, Pa., recently received an order from the Union Electric Co., of Manchester, N. H., for a 500 horse power vertical, cross compound condensing engine. The phenomenal work of a 700 horse power cross compound engine in the station of the Maryland Electric Co., Baltimore, has induced them to place an order a day or so ago for a duplicate with the builders, the Ball Engine Co. The Soldiers' Home at Orting, Wash., has recently purchased a Ball engine, and the Norfolk & Ocean View Street Railway Co., Norfolk, Va., are installing two 125 horse power "Ball" tandem compound engines. The Salamanca Water Works Co., Salamanca, N. Y., are putting in an electric light plant. Two 175 horse power tandem compound engines, built by the Ball Engine Co. will furnish the power.

The Washburn & Moen Mfg. Co. has recently acquired the business and plant of the California Wire Works. These works will be operated in conjunction with the factories at Worcester, Mass., and Waukegan, Ill. Immediate shipments can always be made from the factory nearest the consumer. The location of the factories is admirable as viewed from the point of easy distribution. Offices are maintained in all the large cities of the United States, which have warehouses in connection for the storage of the goods manufactured. The factory at Worcester, Mass., employ about 5,000 operatives, and the Waukegan, Ill., plant has several thousand hands. Bars and insulated copper wire and cables of all kinds for electric light and electric railway plants are manufactured and carried in stock at the various cities where the company has offices.

The Triumph Electric Co., Cincinnati, Ohio, has recently closed orders through the Chicago office for two 35 kilowatt multipolar generators for the A. R. Beck building, South Chicago; one 35-kilowatt dynamo for the John McCabe building, South Chicago; one 15-kilowatt for Albert Schwilt elevator and malt house; one five-horse-power iron-clad motor to Standard Cement & Builders' Supply Co.; a five-horse-power motor to Blakely Printing Co; a five horse-power motor to Northwestern Yeast Co.; two 28-kilowatt and one 40-kilowatt multipolar generator to the Plymouth Refrigerator Co.

The Central Electric Co., 173 and 175 Adams St., Chicago, has been very successful in securing contracts for overhead railway supplies, to which it has given special attention. The railway department is ably handled and is thoroughly posted on new as well as standard material for electric railway construction. The products of Billings & Spencer Co., which are everywhere recognized as standard material, find a ready sale and these departments are kept very busy. The Central company was well represented at the recent convention of the Northwestern Electric Association and gave a special invitation to delegates to call at their salesrooms where a most elaborate and complete exhibit of electrical supplies was to be found. The standard goods of the Okonite Co. and the Interior Conduit & Insulation Co., are carried in large quantities. Okonite wire and interior conduit are in constant and increasing demand.

The Excelsior Heater Co., 337 Rookery Bldg., Chicago, report that they are working their factory to its full capacity and are averaging shipments of a heater a day. They report the following sales for the last week in June and the month of July to date July 25, 1895: Hercules Ice Machine Co., Aurora, Ills., 100 horse-power; Baker & Smith Co., Chicago, 150 horse-power; Ringen Stove Co., East St. Louis, Ills., 150 horse-power; Alton Elec. St. Ry. Co., Alton, Ill., 800 horse-power; Alton Roller Milling Co., Alton Ills., 125 horse-power; Henry F. Blount Plow Co., Evansville, Ind., 100 horse-power; Sand Coulee Coal Co., Sand Coulee, Mont., 400 horse-power; Wilder, Keating & Co., Chicago, 100 horse-power; Rowell & Chase Mchy. Co., Kansas City, Mo., 75 horse-power; Bates Machine Co., Joliet, Ill., 150 horse-power; H. Mooers Co., Milwaukee, Wis., 500 horse-power; Wm. Sharpe & Co., Chicago, 400 horse-power; New Court House, Milwaukee, Wis., 500 horse-power; Star Mfg. Co., Carpentersville, Ill., 100 horse-power; Durand Building, Chicago, 150 horse-power; Health Rail Joint Co., Chicago Heights, Ills., 250 horse-power; Reaper Building, Chicago, 150 horse-power; Seneca Water Works, Seneca, Kas., 100 horse-power; Coffeyville, Milling Co., Coffeyville, Kas., 75 horse-power; Robinson & Cary Co, St. Paul, Minn., 400 horse-power; C. Boettcher, Denver, Col., 600 horse power; Wells-Newton-Quay Co., Chicago, 150 horse-power; Oxford Water Works, Oxford, Mich., 150 horse-power; Citizen's Electric Light & Power Co., Salt Lake City, 600 horse-power; Joshua Hendy Machine Co., San Francisco, Cal., 100 horse-power; Anderton Brewing Co., Beaver Falls, Pa, 100 horse-power; W. L. Lee & Co., Chicago, 50 horse-power; Griffin Wheel Co., Denver, Col., 200 horse-power; Heywood-Morrill Co., Chicago, 1,000 horse-power; Michigan Asylum for the Insane, Kalamazoo, Mich., 300 horse-power.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED: Position as manager or superintendent of central station. Experienced and in every way qualified. Address, 757 care Electrical Industries, Chicago.

WANTED—Position as superintendent of a central station by a mechanical and electrical engineer with eight years' experience, and a thorough commercial knowledge of the business. Address Competent, care Electrical Industries, Chicago.

WANTED—Position wanted as superintendent by a practical and experienced central station man, having been in charge and understanding the different departments and leading systems of lighting; also the economical management of steam plants. First-class recommendations from responsible lighting companies. Address Superintendent, care Electrical Industries, Chicago.

WANTED Position as Electrician and Superintendent of an electric light company, or Superintendent of some construction company. 12 years' experience in general electric construction and management of electric plants having had charge of some of the most important installations in the country. Can furnish the best of testimonials as to ability and attention to duty. Address 756, care Electrical Industries, Chicago.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. September, 1895. NEW YORK. No. 9.

Electric Power in the Operation of an Important Cable Road.

Electric railways have become so common that new roads fail to attract attention except as they possess some new or important feature in their construction or method of operation. The application of electric power in the operation of a cable road is, however, an innovation that occasions surprise and awakens the interest of engineers. The first installation of this kind on the cable roads of our large cities has just been completed, at the 52d and State St. power house of the Chicago City Railway Co. This installation is but one of the changes that are being made in the gradual concentration of the outlying plants in one great plant at 52d St. and Wabash Ave.

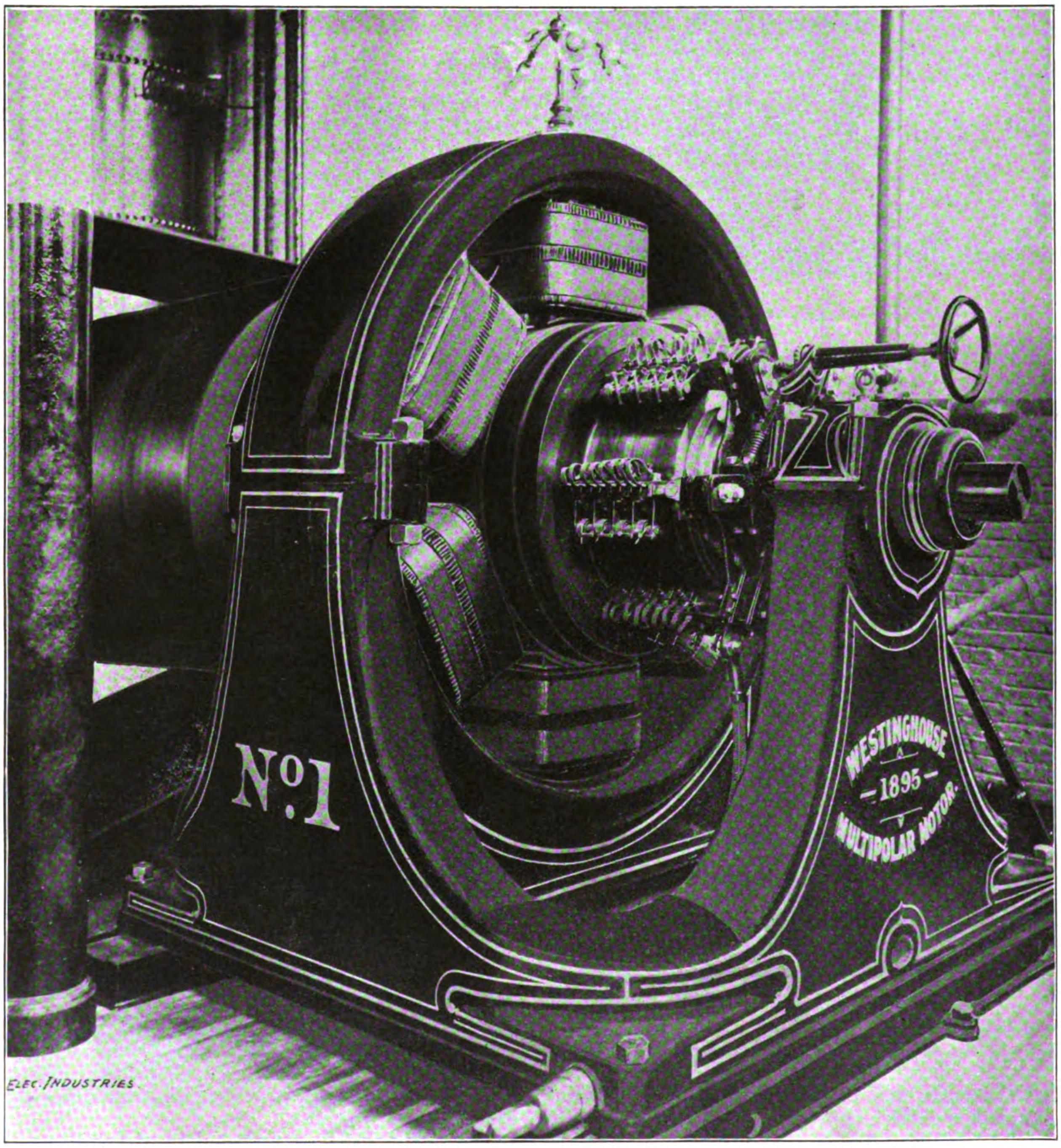

FIG. 1.—ELECTRIC POWER IN THE OPERATION OF AN IMPORTANT CABLE ROAD—THE LARGEST MOTOR IN THE WORLD.

In the power house from which the cable from 39th St. to 63d St. is operated, there are two double engines for driving the cables, one doing the work and the other being held as a reserve. The drive wheel of one of these engines has been taken down and the belt formerly used on the engine running above and below the shaft has been placed on the pulley of a 600 horse-power motor placed a few feet back of engine whose place it has taken. These engines formerly were fed with steam from boilers in this building which are now cold. The remaining engine will be connected with the steam system of the electric power plant directly back of this building. This engine will be held only as a reserve. Should anything happen to the motor or to the electric generators or lines there will always be an engine ready to start up and take care of the load.

This departure has been undertaken as an experiment in the hope of reducing operating expenses. This is looked for chiefly in the saving of labor. One attendant is sufficient with the motor, whereas with the engine an engineer, oiler, fireman and helper are required. With the three shifts of eight hours, this means a saving of nine men. As regards economy of coal, the result cannot be stated off-hand. In both cases the power is developed in the engines. In one case it is applied directly to the work and in the present arrangement it is subject to loss in two transformations, the generator and motor, and in transmission. In electrical machines of this size the efficiency is high. The large amount of electric power furnished by the central power plant enables the number of generators to be varied so that those in use can be operated under their most efficient load.

When the cable is operated by the engine the engine runs light for several hours each day and there is in use an extra set of steam pipes to increase the condensation losses. Most of the large cable roads are operated by two or three independent steam plants. It is estimated that the saving in fuel, etc., in combining these various plants in one large one will offset if not exceed the electrical losses with a system of motors, leaving the saving in labor to the profit of the latter. The company has already seen sufficient evidence of this in the operation of the present motor to convince them of the economy of this method, and are already figuring on a 1500 horse-power motor for the cable plant at 55th St. and Cottage Grove Ave. to be supplied from the electrical power plant.

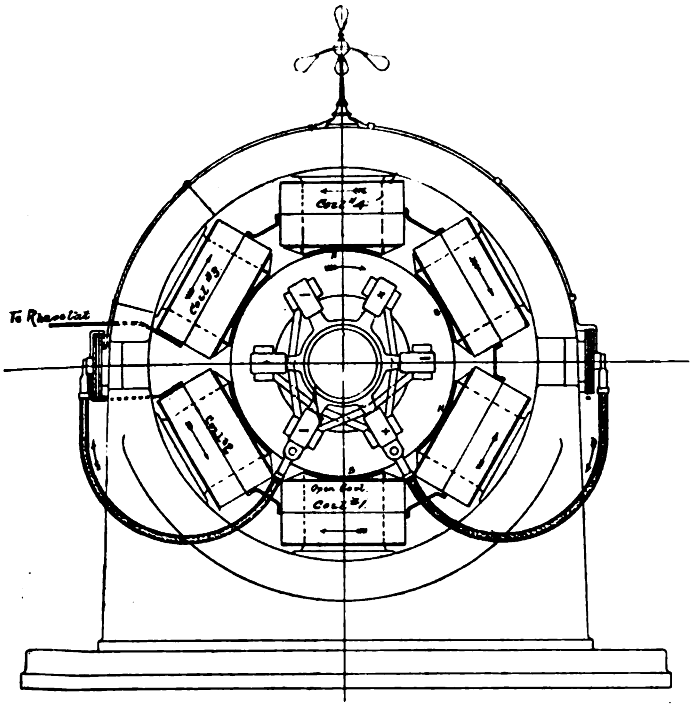

FIG. 2.— ELEVATION OF MOTOR—COMMUTATOR END.

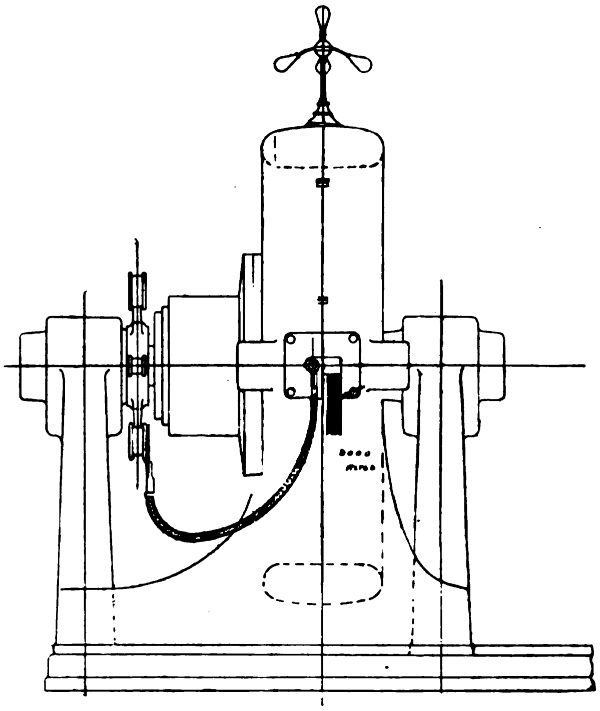

FIG. 3.—ELEVATION OF MOTOR—SIDE.

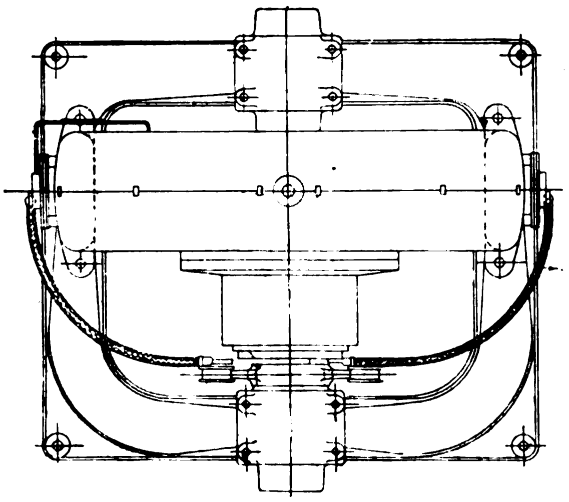

FIG. 4.—OUTLINE OF MOTOR—SHOWING CONNECTIONS.

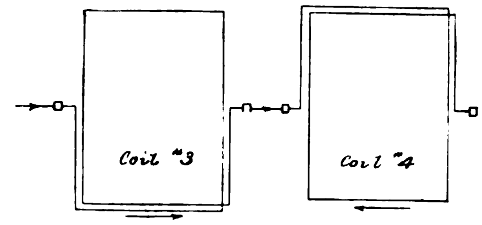

FIG. 5.—CONNECTIONS OF FIELD COILS.

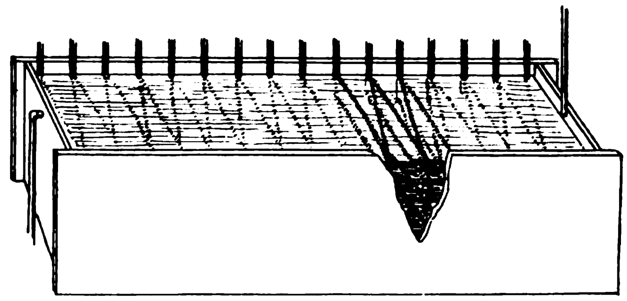

FIG. 6.—OUTLINES OF WATER RHEOSTAT.

FIGS. 2, 3, 4, 5 AND 6.—ELECTRIC POWER IN THE OPERATION OF AN IMPORTANT CABLE ROAD.

The motor, which is probably the largest one in use, operates with perfect success in every particular. It will do all that the engine will do and more. It responds instantly to all variations in load and the surging that is noticable with the engine is entirely absent. One special point of advantage is the facility with which the cable can be examined at night. It also sometimes happens that a splice in the cable will get by the examiner and out of the house before the engine can be stopped. The engineer then backs up the engine by working the valve gear by hand and if he is not careful the engine gets stuck on a dead center with consequent delays. With the motor it is only necessary to throw the reversing switch in the opposite direction, the speed being the same in that direction. By the use of the water rheostat the speed may be regulated down to slowest motion desired.

It was thought by many experts that difficulty would be experienced in getting the motor to start the cable, but it starts as quietly and easily as any piece of machinery. There is no jerk but a uniform acceleration until a full speed is attained in about one and one-half minutes. The current on the start is below the normal full load current, 350 amperes.

The general appearance of the motor which is shown in Fig. 1, is identical with that of the new type of six pole belt-driven generator the Westinghouse Electric & Mfg. Co. have recently brought out. The armature is series wound with solid bars of copper bent over a form to the required shape and shoved through the slots of the armature core from the back toward the commutator end. The bends at the back end forming the cross connections do not extend more than half way to the shaft, thus affording a free passage for the air to and through the ventilating spaces.

The lower field and bed plate are in one casting including the outboard bearing. The whole machine slides on three cast iron rails by means of tension screws for tightening the belt. Its rated speed is 300 revolutions per minute, but is being run at 310. The motor connections are shown in Figs. 2, 3, and 4. The field coils are wound on forms and in placing the coils over the pole pieces the alternate coils are turned a half so as to reverse the direction of the windings, as indicated by the diagram Fig. 5.

The motor switchboard is built up of white marble slabs supported on angle iron bars. The trimmings of the board are polished brass. On the top panels are an ammeter, a hand circuit breaker and an automatic circuit breaker. Below these are a double pole switch in the field circuit and a double pole reversing switch in the armature circuit. On the lower panels are the hand wheels and contact plates of the rheostats. The larger is mounted on a panel 40 by 40 inches and is connected in the armature circuit, being used in starting the motor and in reducing the speed to a very low point when the cable is being examined at night.

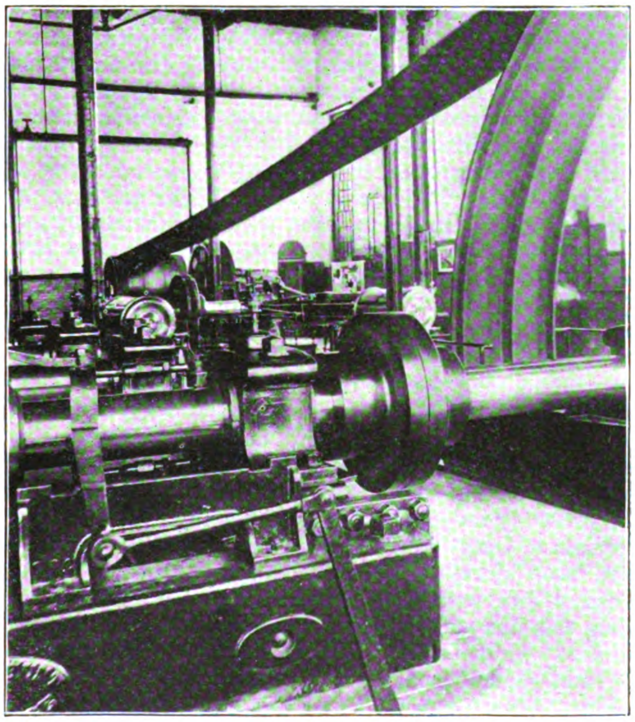

FIG. 7.—VIEW OF MOTOR AND CONNECTIONS.

The resistance of this rheostat is made up of coils of No. 11 B.W.G. extra best quality galvanized iron wire submerged in a tank of water. This tank is placed in the basement beneath the board. The tank is ten feet long by 34 inches by 27 inches up to the overflow pipe. The water is simply to increase the carrying capacity of the wire by lowering its temperature. Should it be so desired a constant stream of water may be made to flow through the tank. This, however, has not been found necessary. The total resistance is about one and nine-tenths ohms. There are sixteen sections, each section being composed of several coils run in parallel. The coils are about one and a quarter inch in diameter, are stretched across the tank and fastened to the sides. The ends of the coils are connected to brass strips secured to the sides of the tank, the latter corresponding in number to the segments on the big face-plate to which they are connected.

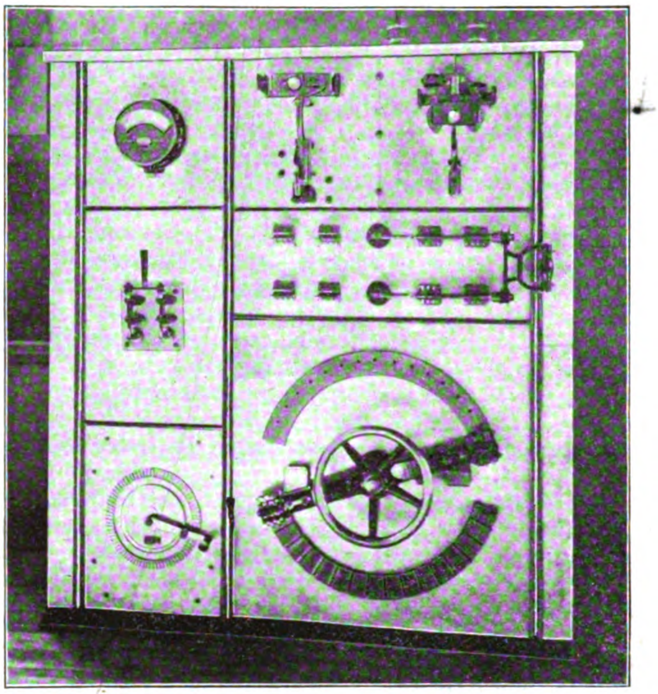

FIG. 8.—THE MOTOR SWITCHBOARD.

Across the terminals of the field winding is placed a high resistance of German silver wire to take up the inductive "kick" when the field circuit is opened. An ordinary rheostat is inserted in the field circuit to regulate the speed. The speed at any one setting of the rheostat is nearly constant at all loads.

The following facts may be of interest regarding the current demanded by the motor. The voltage is uniformly 525. When the motor is running light including kick coil 45 amperes are required. To operate motor with 48-inch belt and 24-foot flywheel without cable machinery, distance between centers 60 feet, 95 amperes are required. When the cable machinery and six miles of cable are driven without cars 275 amperes are required.

The maximum current required with 14 trains of three cars each is 1,000 amperes. The daily average for 20 hours is 510 amperes at 525 volts. The motor takes the place of two 24 by 48 engines making 45 revolutions per minute. Where the engines used about 60 gallons of oil per month the motor uses four or five gallons.

Suit to Test the Validity of the Berliner Patent.

The American Bell Telephone Co. filed suit against the National Telephone Mfg. Co. of Boston, August 6, for alleged infringement of the Berliner patent of 1891. The above company is the manufacturer of the National telephone, in which is used a granular carbon transmitter. This, the Bell company alleges, infringes the Berliner patent. This is the first suit since the recent decision of the government suit. The case will be called early this month. Bills of complaint have also been filed against several other telephone companies of Boston.

The Alternating Current; Its Generation and Distribution.—IX.

BY PROF. GEO. D. SHEPARDSON.

It is desirable to consider next the various kinds of alternating currents in use. The general method is to classify alternating current systems as "single phase," "two phase" and "three phase," or "tri-phase." Sometimes currents of four or more phases are used. The term "polyphase" is used to denote currents of two or more phases, although some writers maintain it should be used only to indicate three or more.

Until within two or three years, all the alternators used for lighting were of the single phase variety. The elementary armature described in the fourth paper of this series (Electrical Industries, January, 1895), develops a single phase current. The ordinary alternator has three or more pairs of poles instead of a single pair, and the armature carries as many coils as there are poles. These coils are coupled in series or in parallel so as to act as a single coil, the large number of poles increasing the number of alternations or cycles per second. Since alternating currents are used largely for lighting, it is necessary to have at least forty complete alternations per second in order to avoid flickering of the incandescent or arc lights. Also the transformers would have to be much larger if the frequency of alternations were less. For the systems in general use, sixteen thousand single alternation (eight thousand complete alternations or cycles) per second have been adopted as giving the most desirable frequency, the recent tendency being to reduce this to considerably lower number. With a single coil armature revolving in a two-pole field, this would involve excessively high speed, hence the necessity for the multipolar field.

Returning to the simple alternator mentioned in the fourth paper (Electrical Industries, January, 1895), Figs. 13 and 14, if the magnetic field is of uniform intensity and if the armature coil revolves at uniform speed, the rate of cutting lines of force will not be uniform. When the coil is in the position shown by the dotted lines in Fig. 13, the wire is cutting or crossing the magnetic field at the greatest effective velocity since the wire is then moving squarely across the field. When the coil is in the vertical position indicated by the solid lines, the wire is moving parallel to the magnetic lines of force and hence at that particular position is not crossing the magnetic field at all. Since the electromotive force equals the rate of cutting lines of force, it follows that the E.M.F. varies from a maximum at the horizontal position to a minimum or zero value at the vertical position. As shown in the earlier paper, the E.M.F. reverses as the coil passes through the zero or vertical position. A curve may be plotted to show the variations of the E.M.F. developed in the coil. Take a horizontal base line as the line of zero E.M.F. Divide the line into equal parts, for example, letting one division represent $\frac{1}{100000}$ part of a second. Let vertical distances above and below the zero line represent the value of the E.M.F. at different instants of time. Starting with the armature coil in the vertical position as shown by the solid lines in Fig. 13, the E.M.F. at that instant is zero. It rapidly increases to a maximum and then decreases, one end of the wire being positive and the other end negative. If the coil is rotating so as to give sixteen thousand alternations or eight thousand cycles per minute, the E.M.F. will rise and fall, reverse, and then rise and fall in the opposite direction, making two complete cycles in fifteen small divisions of time. By careful and somewhat complicated laboratory methods it is possible to obtain exact measurements of the value of the E.M.F. and current at any instant and to obtain as many measurements as desired at equal intervals apart. From the results of such measurements curves have been plotted for the E.M.F. developed by alternators of many different makers. The ideal curve shown in Fig. 22, known as the "sine curve," is closely approximated by several different machines such as the Westinghouse and the new Standard. Such a curve representing the variation of E.M.F. from instant to instant is obtained by plotting the instantaneous values of the E.M.F. developed in a wire loop rotating at uniform speed in a uniform magnetic field. In the actual alternators, the magnetic field is not uniform nor is the armature coil a single loop of wire, yet the E.M.F. may be made to approximate the ideal sine curve by properly designing the pole pieces and the armature coils in respect to width and distance apart. Having the E.M.F. follow the sine law brings certain advantages such as less loss in the transformers and less noise in arc lamps.

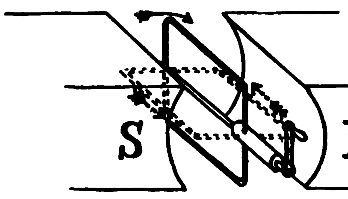

FIG. 13.

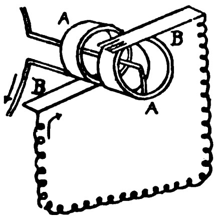

FIG. 14.

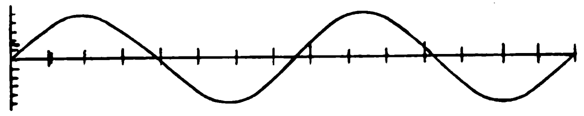

FIG. 22.

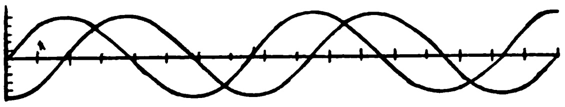

FIG. 23.

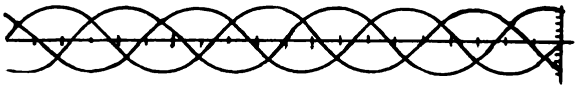

FIG. 24.

Simple alternating currents such as obtained from the ordinary single phase alternators are well adapted for lighting purposes. When it is desired to operate motors, however, difficulties multiply. Small series wound motors will work about equally well with alternating or direct currents, provided that the iron cores and other metallic parts in the magnetic field are well laminated, so as to avoid induced currents. Series motors do not run at constant speed with variable load, and hence are only suitable for fan motors or similar work at constant load. Shunt wound motors will regulate speed, but have little starting power with alternating currents. Induction motors, having the field excited by the simple alternating current, and having the armature wound with closed coils without any connection with the line, will operate satisfactorily and run at almost constant speed after being once brought up to speed. But such motors have only little or no starting power and must have a small auxiliary motor to bring them up to speed. Such are known as "synchronous" motors, since they run at the same speed as the generator. Synchronous motors are used in some large plants, and are very satisfactory where it is not necessary to stop and start the motor frequently.

Since the simple or single phase alternating current is not well adapted for the distribution of power for miscellaneous motors, it was necessary to develop some other system by which alternating currents could be used generally for power as well as for lighting purposes. A successful method was discovered at almost the same time and probably independently by Tesla in United States, by Ferraris in Italy and by Borel in France. Tesla's inventions have been developed into commercial machines by the Westinghouse company. Other inventors have worked along this line and the Stanley and General Electric Companies are now putting out excellent apparatus based upon the same general principles.

The discovery which led up to a successful self-starting and self-regulating alternating current motor was that a rotating magnetic field is obtained when two alternating currents, one of which is a quarter cycle later than the other, pass through two magnetizing coils placed at right angles to one another, or through a set of coils placed around in a circle and so connected that the two currents circulate in alternate coils. The explanation of the action of the rotating magnetic field will be undertaken later in connection with the distribution of the alternating current, the purpose at the present time being simply to indicate the source of the desirability of something more than simple alternating currents.

The simplest way to obtain two alternating currents, one of which is right angles to (or one quarter phase apart or ninety degrees apart from) one another is to wind upon the same armature a second coil or set of coils,so placed that the E.M.F. induced in one coil is at a maximum when the E.M.F. induced in the other coil is at a minimum. The curves of the two E.M.F.'s at right angles may be represented by Fig. 23. Since the currents follow closely the same curves as the E.M.F.'s, it is seen that the magnetizing power of the current in one set of the field coils of a motor is zero at the instant when the current in the other set is at a maxiumum value. Another way to obtain two alternating currents at right angles is to key two armatures upon the same shaft, but having one set around further than the other, both revolving in a common set of field pole pieces or having separate set of fields for each armature. The twelve one thousand horse-power Westinghouse generators used for incandescent lighting at the World's Fair were two-phase alternators made in the latter fashion. The two phase alternators of the Stanley company have the two sets of armature wires laid in grooves in the exterior stationary armature core while the field revolves inside. The Heisler machines used for series incandescent lighting are also two phase alternators with stationary exterior armature and revolving interior field. The two currents from a two phase alternator may be transmitted by four wires, each current having an out and return wire; or it is practicable to dispense with one wire, using a common return.

The operation of an alternate current motor is still more uniform and satisfactory if it is driven by three currents displaced so as to be sixty or one hundred and twenty degrees apart. Curves of E.M.F. for three such currents are shown in Fig. 24. Such currents might be generated by machines similar to two phase alternators, but having three sets of armature coils instead of two. Each set of coils might have its own collecting rings and two wires for the external circuit. As with the two-phase system, it is practicable to join the armature coils at a common point and to use a common return wire for all three circuits. But here an interesting fact comes in, that if the currents in the three outgoing wires are equal and are displaced so as to be equally separated (that is, one hundred and twenty degrees apart), the sum of the instantaneous values of the three currents at any instant is zero. This may be seen by adding the vertical distances representing the value of the three E.M.F.'s or currents at any point, for it will be found that the sum of the positive values or the distances above the zero line is exactly equal to the negative values at the same point. For example, at the vertical line at the left side of Fig. 24, when one current is zero, another has the same positive value as the negative value of the third. The result is that the common return wire would carry no current at all and so is useless and may be omitted entirely. In three-phase generators, therefore, the three sets of coils may be joined at a common point that has no direct connection with the outside circuit. The Thomson-Houston arc dynamo with three coils or sets of coils connected by a ring at the pulley end would be a three-phase generator if the three-part commutator was replaced by three collecting rings connected with the terminals of the three coils.

Alternators for generating two or three-phase currents are under some disadvantage when supplying circuits for both power and lighting. Each motor is generally connected with each of the three or four wires from the alternator, while the lamps are usually of the common kind with two terminals and of course each lamp is connected to only two of the wires. Unless the lamps are carefully divided so that the same number are connected on each circuit, some of the armature circuits must deliver more currents than others, and some of the line wires carry more than others. As a result, the voltage will drop more on one circuit than on another and the lamps will burn at unequal brilliancy unless some means is provided for regulating each armature circuit independently. In the Westinghouse two-phase alternators, with two armatures and two sets of fields, it is possible to vary the exciting current in either field exciting circuit, and so regulate the E.M.F. on either side of the system. Alternators in which the two or three-phase currents are induced by armature circuits in the common field, have no means of varying the E.M.F. in one circuit without affecting the others proportionally, unless some external compensating device is introduced outside of the machine. Advocates of such a system claim that in actual practice the load remains balanced so closely that no difficulty is experienced in keeping the lamps at proper brilliancy, and consequently no special balancing regulation is necessary.

In order to avoid the unequal regulation expected from the ordinary two and three-phase alternators when used for both lighting and power, the General Electric Company advocates the so-called "monocycle" system. Really this is a variety of three-phase alternator so designed that all the lamps are to be supplied from two of the armature circuits and from two line wires connected with their outside terminals. The third armature circuit develops less E.M.F. than the others and is used only for motor circuits. Motors are connected to the three wires and receive three currents of different phase, one between the two lighting mains and one between each lighting main and the third wire. By an ingenious method of designing the transformers used between the mains and the motor, the three currents at the motor are so displaced as to be one hundred and twenty degrees apart and might be represented by the curves in Fig. 24. The details of how the three equally spaced currents are obtained can be understood better after studying the principles of the transformer.

How Electricity Sets Fire.

William McDevitt, chief of the Electrical Department of the Philadelphia Underwriters' Association, in a recent issue of the Boston Transcript, gave a demonstration of some of the ways in which fires may be caused by electricity. The first danger was that arising from the common practice of grounding telephone wires on gas pipe. A bad connection is generally made—quite sufficient for telephone purposes—and then if the telephone wire becomes crossed with an electric light wire, the larger current meeting resistance at the ground connection heats the joint, punches a hole in the gas pipe, and the arc formed lights the gas. Mr. McDevitt gave a complete demonstration of the gas and insulation on the wire burning simultaneously. He also exhibited a section of gas pipe that had caused a fire in just this way: The wires in the sockets of electric lamps are liable to touch the casing, when an arc may be formed. For this reason, no drapery should be used around the lamp sockets. The advantage of using metal conduits with insulated lining through which to run the wire was demonstrated, a wire outside being dangerously heated, while from that inside the conduit there was no risk. A caution was given against the rough handling of flexible cords used for electric lights as a common cause of short circuits and fire. There are other dangers due to ignorance on the part of the general public of the character of the electric current. In one case on record, the walls of a room were upholstered with stuff in which were interwoven a great number of metal threads. These were in contact with the electric light wires, and when the current was turned on the whole room was set ablaze. An obscure danger from frictional electricity has been traced. Sparks may be caused by shuffling the feet on carpet or by the rubbing of silk. Where benzine is used to clean such materials, a spark thus caused may give rise to a dangerous fire. It is believed that some benzine fires have been caused in this way. Another cause of fires is the unreliability of fuses. They are put in the line to be burnt out when an excessive current is turned on, but, like safety valves, they do not always work. If they fail to fuse, a dangerous current may be carried along the line. To obviate this danger, a standard should be adopted.

"I am very much pleased with ELECTRICAL INDUSTRIES. I have taken the——— for the last seven years but I think your paper is far ahead of it." FRED. A. BLAKE, Eln. Rice, Barton & Fales Mche. & Iron Co., Worcester, Mass.

The Siemens & Halske New Type A Generator.

Although the mechanic puts into metal the ideas of the designer, the success of the machine rests largely with its originator. If the design is defective the skill of the workman is unable to produce a perfect machine; while if the designs are correct the mechanic is able, if possessing the requisite skill and tools, to bring out a successful mechanism. In the design of no class of machinery is so thorough a knowledge of metals necessary as in the design of electrical generators. Not only must the mechanical properties of the metals be well understood but also their electrical and magnetic capacities and efficiency. The increased knowledge of these qualities of iron and copper has enabled engineers to greatly reduce the amount of metal used in a generator of a given output and consequently its size.

In the design of the generator herewith illustrated, which has recently been brought out by the Siemens & Halske Electric Co. of America, the most noticeable feature is the design of the magnets. For many years armature cores have been built up of thin plates of sheet iron stamped of a uniform size from the large sheets. The greater magnetic capacity of laminated iron over either cast iron or steel as well as the greater uniformity in the quality of the part so constructed, led to the universal adoption of this method for armature cores. In cast metal blow holes, hard spots, etc., are liable to occur and remain undetected. But when built up as above described a homogeneous cross section is obtained at all points.

This method has been employed in the construction of the magnets of this generator. The laminated magnets will be noticed in the cross section drawing, Fig. 2, which is a vertical cross section in the direction of the armature shaft. These laminations are held securely in place by the webs projecting internally from the frame which comes down over the coils and the end of the armature, thus making the machine practically iron clad. The magnet core and yoke are continuous without any connecting surfaces and the core extends straight through to the surface of the armature, having, of course, the necessary clearance. This method of constructing the magnets secures a minimum weight and a maximum efficiency.

In order to distribute the lines of force pole horns are provided, which consist of cast steel tips attached to a sleeve that fits over the magnets. These horns are shown in Fig. 3, which also shows the method of connecting the horns for greater stability, by the bolts at the corners. The field coils are wound on these sleeves and can be removed with the sleeves. Machine wound magnet coils can thus be used. The above construction produces a machine whose center of gravity is very low and the tendency to vibrate is at a minimum.

In the construction of the armature core the usual practice has been followed, punchings of selected iron, built up to the desired size, forming the core. These are held in place by the end plates as shown. Both the magnets and armature core of the generator which are of finely laminated iron are unsurpassed for uniformity and efficiency. The core is slotted to receive the windings, which are of the bar type. These windings are illustrated in Fig. 2 which shows the straight bar reaching nearly to the commutator. The end connectors are mounted all together on insulating blocks before being placed on the machine. They are held securely in place on this block by binding wires which prevent any movement of the connectors, and thus all liability to short circuits by reason of the abrasion of the insulation through the movement of these ends is provided against. The insulation is of the standard kinds used by this company and the conductors are not only perfectly insulated for all possible potentials, but mechanical protection is afforded the insulation wherever there is the least liability to injury. This style of winding has been found not only most durable but also most efficient. It is easily repaired, should it become necessary at any time.

The commutator is large in diameter and of sufficient length to give ample brush surface. It is constructed of

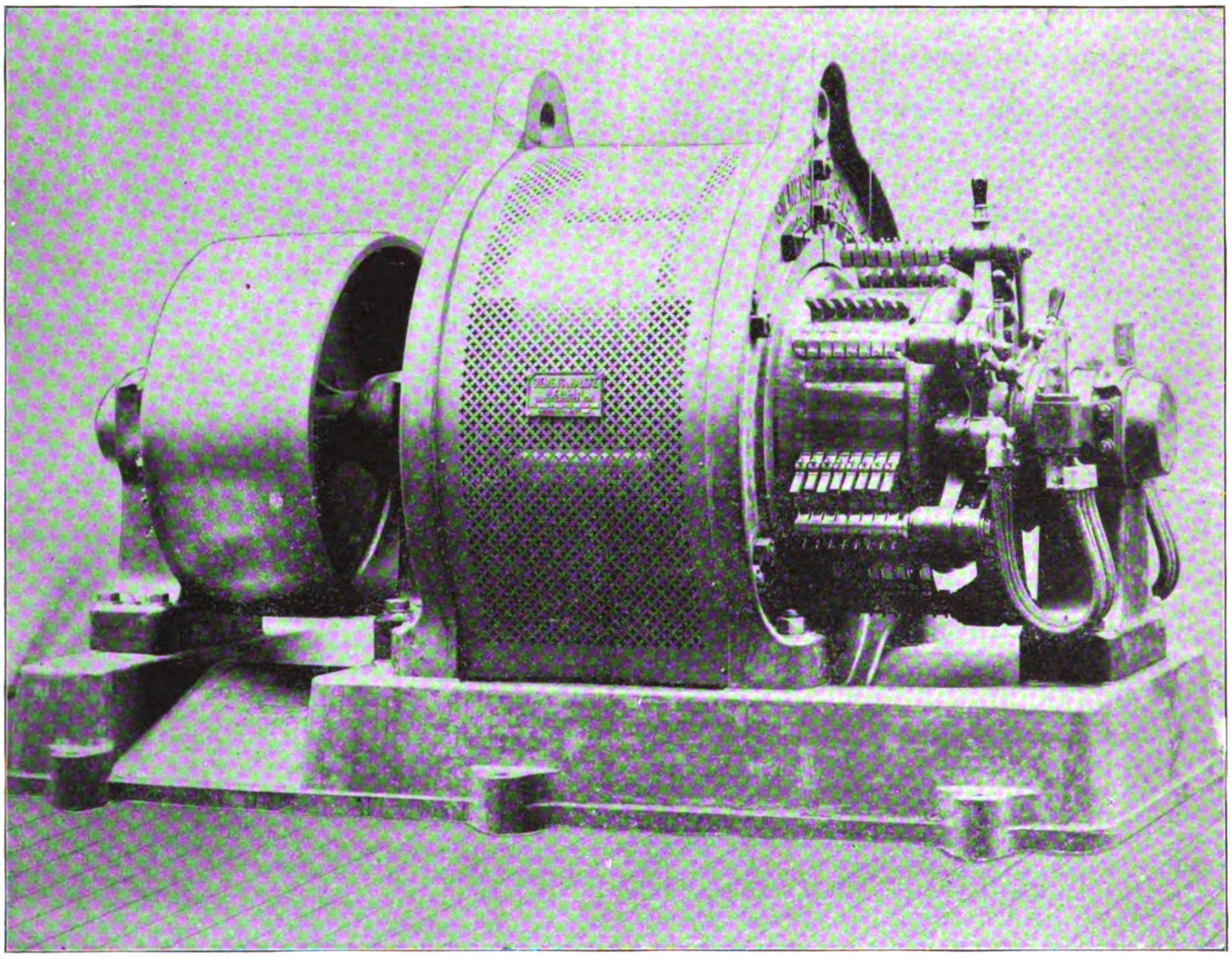
FIG. 1.—THE SIEMENS & HALSKE NEW TYPE A GENERATOR.

copper segments which can be replaced without unsoldering any joints. A special spider supports the commutator and is of a form that holds the insulation and segment securely. This part of the generator has received special attention. The commutator has been designed with a view to giving the greatest durability and ease of repair. The liability at any time of a segment becoming injured requires that the replacing of the segment be a matter easily accomplished.

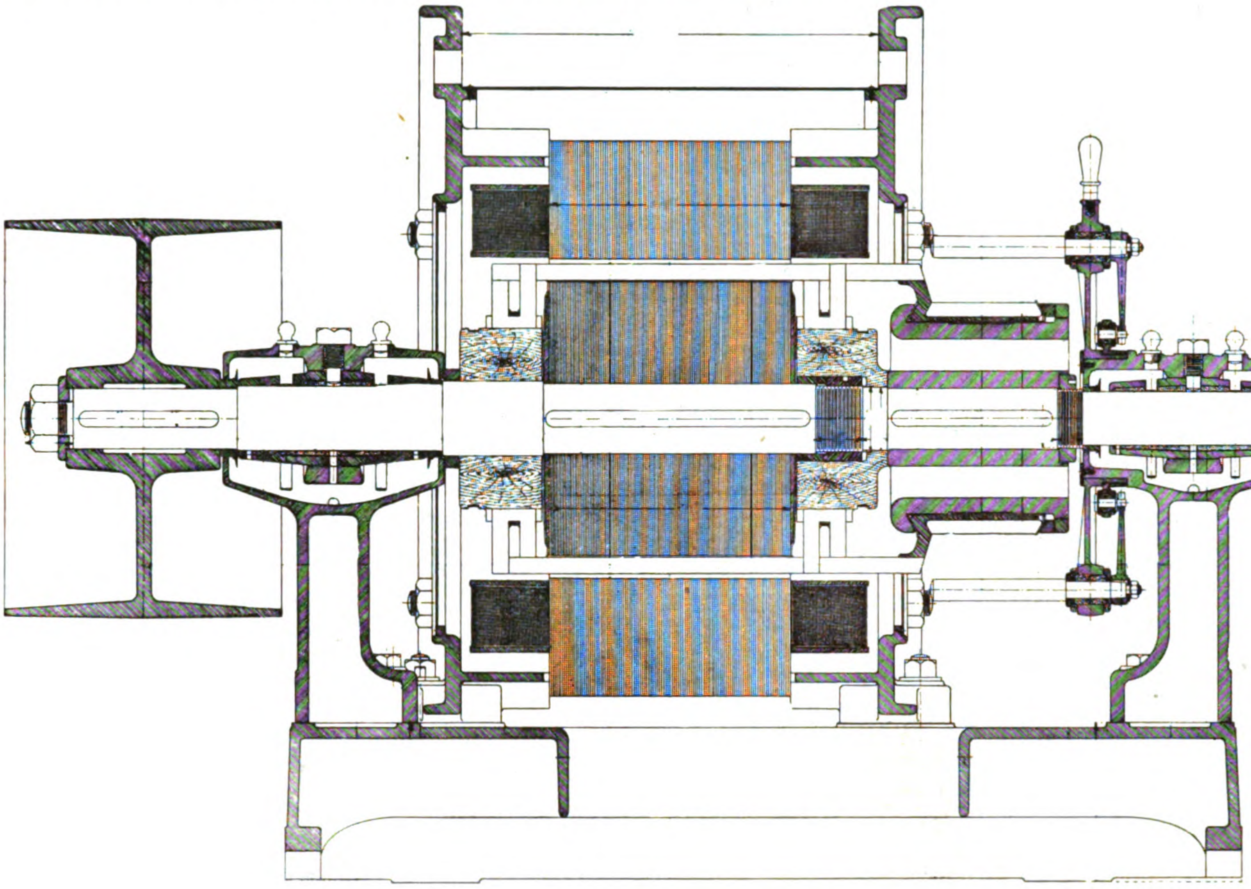

FIG. 2.—VERTICAL CROSS SECTION.

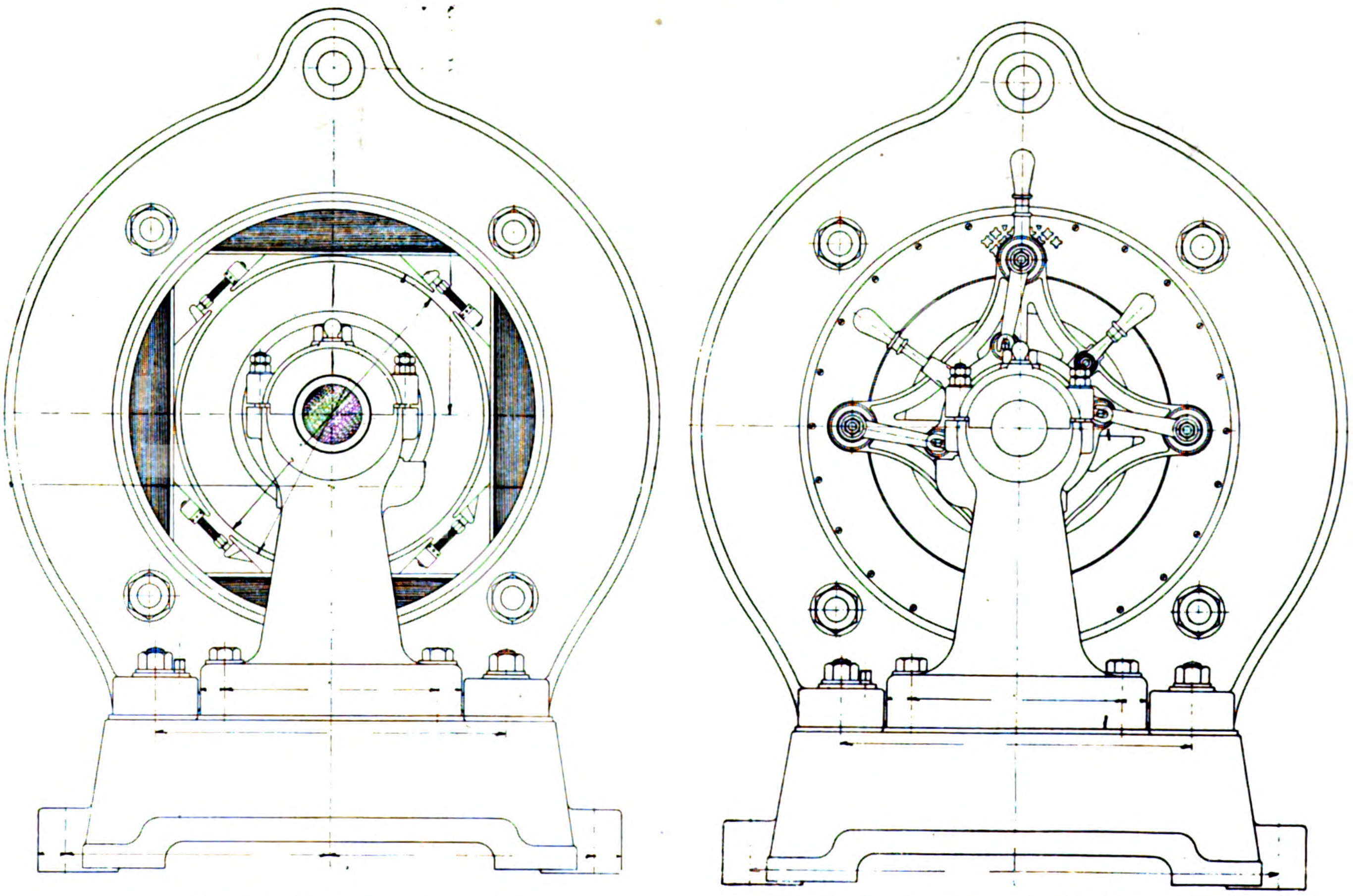

FIG. 3.—ELEVATION OF PULLEY END.

FIG. 4.—ELEVATION OF COMMUTATOR END.

FIGS. 2, 3 AND 4.—THE SIEMENS & HALSKE NEW TYPE A GENERATOR.

The brush holders are easily adjusted and give a uniform pressure of the brushes on the commutator. They are supported on arms projecting from a star. This star, although appearing very simple, is so constructed as to raise the brushes from the commutator or to shift them in either direction. In Fig 4, which shows the commutator end of the generator, it will be noticed that there are three handles on this star. The one at the right releases the collar to which the levers on the ends of the brush arms run and by the movement of the brush star the brushes are raised from the commutator. The handle at the left releases both collar and star and the movement of the brush star shifts the brushes. This arrangement is provided with all generators of more than 50 kilowatts capacity.

The bearings are self-oiling and self-aligning. A special construction prevents the oil working along the shaft toward the commutator. The shaft is large and gives a rigid support to the armature. The sides and ends of the dynamo are covered with perforated sheet iron, a suggestion of the perforations only being shown in Figs. 4 and 5. This gives the machines a neat external appearance and protects the interior from injury, while at the same time giving sufficient ventilation. Fig. 3 is a view of the pulley end, the pulley and perforated covering being removed. The base of the dynamo is large and well proportioned, affording a substantial support.

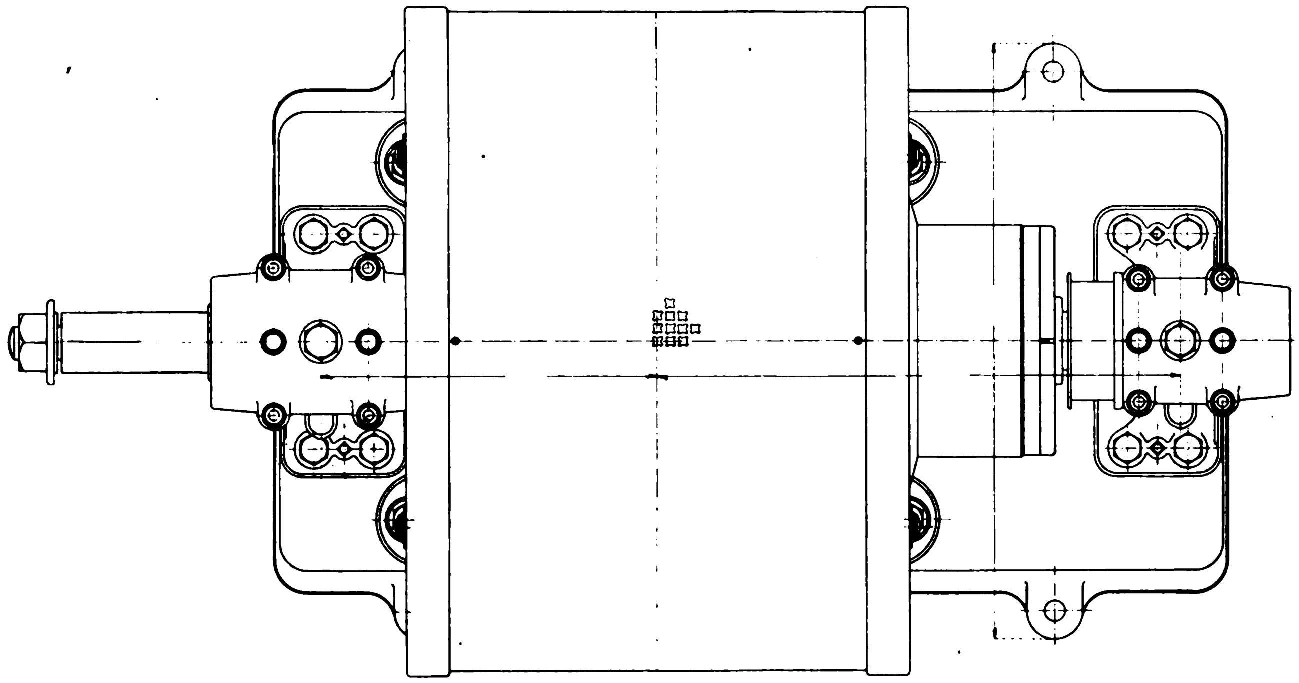

FIG. 5.—SIEMENS & HALSKE NEW TYPE A GENERATOR—PLAN.

In Fig. 1 is shown a complete machine of this type with six poles. It has a capacity of 150 kilowatts and its speed is 350 revolutions per minute. An extra bearing is placed outside the pulley and the base has been extended for its support. Its design with these slight changes which have been necessary on account of its greater size, is as described above. The Siemens & Halske Electric Company have kept two main points in view in the design and construction of this line of generators—high efficiency and long life. An intelligent design with the careful selection of material and its skillful manufacture has produced a line of generators which have already proven that these two points have been attained.

Pennsylvania Street Railway Association.

The fourth annual convention of the Pennsylvania Street Rairway Association is to be held at Wilkesbarre the 4th and 5th of this month. Most excellent accommodations have been secured for the association in the Ninth Regiment Armory, where ample space is provided for exhibits of street railway appliances. A good attendance is expected.

Canadian Electrical Association.

The annual convention of the Canadian Electrical Association is to be held at Ottawa, Canada, on September 17, 18 and 19. For the entertainment of the members while in Ottawa the local committee is in charge of the arrangements. The attendance, it is expected, will exceed that of the successful meeting at Montreal last year. The papers to be read at this meeting promise to be on timely topics of interest to the fraternity.

The Photometry of Arc and Incandescent Lamps—I.

BY PROF. W. M. STINE.

One of the most encouraging indications of the stability and development of electrical applications is the wide interest which those who are engaged in electricity from purely practical reasons, are taking to understand the principles underlying this class of industries. Simply and clearly written articles on the design and construction of electrical apparatus, and its proper management, are read with an interest which indicates that electrical installations in the future will be better planned and more profitably operated, because more intelligence and knowledge are to be put into them. But there is another line along which education is more urgently needed; that is, the more important electrical measurements which are necessary for the successful operation of both lighting and power installations. The electrical industry, more than any other, necessitates accurate and varied measurements. It is simply an appeal to common sense to state that thorough measurements of all apparatus and accessories insure the best economy in purchasing. In no other way can purchases be made intelligently, and the exaggerated claims of advertisers be sifted for truth. Fortunately, the average electrician may quite readily acquire the knowledge and skill to make all ordinary tests that are necessary. The cost of needful apparatus, if intelligent care is exercised, is not excessive.

There is one class of measurements about which little is generally known, and it is the purpose of the present article to clearly state the elementary theory and practice of this class, which forms the subject of the article. We have become so accustomed to such expressions as "16 candle-power" for incandescent lamps, and "2,000 candle-power" for arcs, that these designations on lamps are taken without question. The present large number of makes of incandescent lamps and the varieties of arc carbons, make it extremely difficult to know just which brand to purchase. It must be borne in mind that it is the lamp which finally converts the electrical energy derived from the coal pile into light, and further, that all payments for this energy are based on the light produced, and that those causes which influence both the quantity and the quality of the light make themselves felt on the receipts. In several papers by the author, attention was called to the great variation in the light emitted from arc lamps by the carbons. In some cases it was found that fully 30 per cent. of the energy was wasted, a result which no one careful of station economies, can afford to overlook. Equally great wastes may occur in incandescent lighting.

Photometric, or candle-power measurements, are not too difficult to be made in the general operation of central stations. They require both care and patience, and simple apparatus will be sufficient. Their value in disputed cases alone will abundantly repay all the expenditure of time and effort. The elementary theory of such measurements will treat of (a) the quality and quantity of light; (b) the standard of candle-power; (c) the distribution of light in both the arc and incandescent lamps; and (d) the principles of the measurement of candle-power. The practice will deal with (a) the description of a simple photometer; (b) the use of the simple photometer; and (c) directions for constructing a simple photometer.

THE QUALITY AND QUANTITY OF LIGHT.

The most superficial observation shows that a marked difference exists between nearly all kinds of illumination; the candle flame is different in color from the kerosene and gas flames, and these again are easily distinguished from the incandescent light, while the arc light is strikingly different from all. To one who has given little attention to this subject, one light is simply whiter and brighter than another. Just now electric light men are compelled to meet competition from the Welsbach gas burners, and are, no doubt, often perplexed to know how to explain the difference between such illuminants and the arc and incandescent lamps.

This division of our subject may seem at first to have little practical significance, yet it is after all so fundamental and important that it must be carefully considered. It is light which is in any case sold, and the satisfaction given to customers will depend on careful attention to both its quality and quantity.

Photometry is a class of measurements having to do with the quantity of light, but the difficulties encountered in candle-power ratings arise chiefly from variations in quality.

In the first place, all light, as generally produced, is similiar in that it is due to highly heated or incandescent carbon. This is as true of both the arc and incandescent lights as of the sooty oil flame. A general statement may now be made of all incandescent carbon lights in air: The quantity of light depends upon the amount of incandescent carbon in its source, its temperature, and power of emitting light; the quality depends almost wholly upon the temperature. In order to illustrate these principles in their bearing on our subject, suppose a 16 c. p. incandescent lamp for 110 volts be connected in series with a rheostat of about 300 ohms, across 220 volt main. The lamp will burn below candle-power with a reddish light. If the resistance is slowly cut out, the lamp will come up to candle-power and gradually grow brighter, until, if the filament stands 220 volts for a short time, the color will be a dazzling white, with a decidedly bluish cast, while the candle-power will have increased until it is nearly that of the ordinary arc lamp. What has been the only change which has occurred in our light source? As the resistance was decreased the current increased, and the lamp grew hotter, or, in other words, the C^2R loss in the filament constantly increased. There has been a change in the amount of light emitted, and an equally great change in its quality, all as the result of an increased temperature. In order to understand the changes that have occurred in this case, we are compelled to go into the physics of light. The familiar prism and spectrum experiment shows that all ordinary "white" light is made up of colors, shades of red, yellow, green and blue. The quality of any light will depend upon both the presence and intensity of these component color-groups. When the incandescent lamp burns low the red and yellow rays are mainly present; as it grows hotter the greens and blues are added, until, when all are present in correct proportion, the light is pure white. Analysis of the components of ordinary lights shows that the candle and oil flames are made up mainly of red and yellow, with some green and faint blue rays. Such lights, as is well known, are poorly suited to bring out the colors of cloth containing either green or blue shades. Ordinarily, the incandescent light is yellow, but it contains a greater proportion of both the green and blue components and is so much better adapted to bring out colors. In the arc light, however, the entire spectrum is fully developed, the greens and blues being so pronounced as to give the light a bluish tinge. It is thus the light best adapted for displaying colors in general, though it exaggerates any that contain either blue or green shades. The spectrum of Welsbach gas flames is irregular and poor'y distributed, and the red rays, and, when old, the green, are excessive, and give the light a sickly glare. Merchants who have discarded the arc light for this illuminant are finding it not suitable for displaying colored goods.

THE STANDARD OF CANDLE-POWER.

The considerations just stated serve to illustrate the difficulty in adapting a standard of quantity which shall apply equally well to all classes of illumination. This is a real difficulty, and gives rise to great uncertainty in candle-power measurements. It must be confessed that candle-power measurements are the least satisfactory of all the various electrical measurements. This must be accepted simply as a fact, and not as an excuse for neglecting the value of such measurements. The ohm can be determined to within an error of $\frac{1}{100}$ per cent., the ampere and volt to $\frac{1}{10}$ per cent., and we may be positively certain of the correctness of our measurements. In general, the candle-power of either the arc or incandescent lamp can not be relied upon within from 2 to 5 per cent. But candle-power is different from other measurements, and an accuracy of 1 per cent. would be entirely sufficient for all ordinary tests; even 2 per cent. is allowable. The eye is such a poor judge of slight differences of illumination that great accuracy in light values is not so essential. The essential requisite, however, is to understand the principles from which the difficulties arise and the extent of errors to which candle-power measurements are subject. Lamps are rated in candle-power and cannot be satisfactorily rated in any other way. An attempt has been made to rate arc lamps by the watts absorbed, but it will be shown why this is not practicable. The adoption of a candle flame for a standard came about in a natural manner. It began when the change was made from candle light to kerosene and gas. Once established as a customary standard, it was applied to the arc and incandescent lamps as they were introduced.

The generally accepted standard of illumination is the candle. But all candles are not alike, and any one candle may vary considerably in the amount of light it emits, depending upon the length of wick, the size of the wick, the number of strands it contains, etc. These variations very often amount to as much as 15 per cent. It will readily be seen that a standard candle must be used under well-understood conditions. There are two classes of standard candles on the market, the spermaceti and the paraffine. There is little to choose between them, though the paraffine candle seems subject to great variations. The wick should in all cases be braided, and the candle, when giving its unit light, should burn with a flame of 1¾ inch height for spermaceti, and 2 inch for the paraffine class.

As may be supposed, scientists have been to an enormous expenditure of time and pains to find some better light standard; one that could be reproduced with ease and certainty and not vary when in use. So far, such researches have not met with complete success. Even were these features obtained, the difficulties in dealing with lights of different qualities would still interfere with its general application. The best standard at our command is a lamp burning amyl acetate, fitted with proper devices for maintaining a constant height of flame. An accuracy of 2 per cent., or smaller, error is readily obtained with this standard, and besides, the quality of its light is similiar to that of the incandescent lamp. In short, for all practical purposes, the amyl acetate standard is sufficiently satisfactory for measuring the illumination of both arc and incandescent lamps. The importance of the kind of standard used by manufacturers is seen when measuring lamps from a number of makers; the candle-power for a nominal 16 c. p. lamp often lies between 12 and 20 candles.

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To unwrap your paper, pull out the string which you will find in the wrapper.

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The installation of an electric motor at the 52d St. cable power house of the Chicago City Railway Co. for driving the cable system from 39th St. to 63d St. is certainly a departure from the usual practice. At first glance the cause for discarding the engine and the substitution of the electric motor is not apparent but the change has been made only after the advantages and disadvantages of the two methods have been studied and compared by the company's engineers. The question of economy received the greatest attention and the motor seemed to promise a large saving in operating expenses. It has also been found, since the motor was put in service, that it possesses other advantages over the direct use of the steam engine. The difference in the noise made by the gears is at once noticeable. The instant response of the motor to the slightest change in load gives a uniform pull on the cable. The speed is almost constant and the cars seem to run more smoothly. The ease with which the motor is reversed is also in its favor, permitting the cable to be drawn back, if a broken strand or splice gets by before the cable is stopped, with very little trouble. It also starts quickly and requires a minimum amount of attention.

Tests are now being made of this installation which will show the exact work being done and its cost as compared with the former method. Sufficient evidence of its economy has already been secured to show that the estimates were approximately correct. It has been found that the coal consumption has been decreased for the reason that for many hours of the day the large engines were operated under a light load, which is far from an economical load. At the present time the units in the electrical power plant may be so arranged as to be operated under their most economical load at all times. The generators are of large size with good efficiency and it is expected that the saving made here will almost balance the loss in the transformation and transmission. The saving is in the matter of labor one man being now sufficient where four men were previously required. The wages of nine men are here saved, the men working in three shifts of eight hours each. Although the power house possessed a complete equipment the saving that this method seemed to offer was sufficient to warrant the change being made. This was quickly done, no change in arrangement of power plant being necessary.

In the operation of the more important cable systems two and often three power houses supply the power, while in the electric railway systems the power plants are consolidated at a central point, the economy of one large power plant over several smaller ones being unquestioned for such systems. The continued operation and tests of this equipment on the Chicago City Railway will probably show that a central power station can furnish power most economically for a cable road, the electric power being transmitted from the central station. The above company is sufficiently convinced of this fact as to contemplate the use of electric power from the electric plant in the cable power house at at 55th St. and Cottage Grove Ave. This power house will require 1,500 horse-power of motors. It often occurs that the location of a power house at a particular point is objected to on account of smoke and dust, which would not occur in the case where electric motors are used. The ground space required for the location of the power house would be greatly lessened, there being no boiler plant, no space for the delivery and storage of coal required. In the construction of future cable roads the use of electric motors for driving the cable will unquestionably receive careful consideration.

The article in this number contributed by Prof. Stine which is the first of a series on photrometry, will undoubtedly be of interest to all connected with the commercial production of illuminants or the study of their use. These articles will cover in a comprehensive manner the subject of measurement of arc and incandescent lights. They will not enter into a discussion of the value of illuminants or the purely theoretical study of light but will present the subject in a manner especially intended for those engaged in the lighting industry. In this number the quality and quantity of light and the standard candle power are considered. Future articles will touch upon the distribution of light in both arc and incandescent lamps, the principles of the measurement of candle power and the description, construction and use of a simple photometer. The subject is one of importance and should be well understood. No one can intelligently select or conduct the operation of lighting devices without a knowledge of illumination and its measurement. The purchase of supplies, of carbons or incandescent lamps, in order to secure the most efficient on the market, requires a knowledge of the photometer and its use. A few simple tests will show the difference, if a difference exists between the illuminating power of two different brands of carbons. There are methods understood by nearly every engineer for measuring the work being done by the engine, which is not more important in the production of light than the apparatus that transforms the power into electricity or that transforms the electricity into light, yet comparatively few engaged in the lighting industry are able to measure the illumination of a lamp or compare, except very roughly, the relative efficiency of two lamps. This subject will undoubtedly be given greater attention in the future as central station men are studying every means to increase the efficiency of their plants.

The application of electricity to steam roads is receiving the serious consideration of many engineers, more so this year than ever before. The equipment of several feeder lines of important railroad systems shows the steam railroad companies are studying the subject and have reached certain conclusions regarding this form of power as applied to the great transportation system. It is becoming more evident that on certain lines electric power for certain kinds of traffic can be adopted with profit, while on other lines the steam locomotive will show the greatest economy. The want of knowledge on this point has already cost many persons considerable sums, having been induced to invest in roads on which the use of electricity was only a matter of experiment. The electric motor has already encroached upon the domain heretofore occupied exclusively by the steam locomotive and will unquestionably enter still farther this domain, but there is a line separating the field in which the steam locomotive will continue to be the most economical method of transportation, beyond which the electric locomotive cannot for the present hope to go.

This subject has been well presented in the recent address of Dr. Louis Duncan before the American Institute of Electrical Engineers. Regarding the railway systems now operated by steam whether it would pay to change entirely to electricity, or to make a partial substitution and how the substitution should be made, he says: "There are two distinct sides to the question of transportation, the passenger and the freight side, and their requirements for good service are very different. First taking up the question of passenger travel, the receipts of the road are increased by running trains at short intervals and at high speeds and this is a condition peculiarly favorable to electricity. On an electric line short trains equally distributed over the track, give a greater station efficiency and the lowest cost of equipment of both station and line. The cost of train service is greater but is compensated for by the saving in the other items. The cost of hauling a given number of passengers between given points by steam is greatly increased when the number of trains is increased, the efficiency is less and the cost of equipment of train service is greater. Wellington states that doubling the number of engines for a given traffic increases the cost of transportation fifty per cent."

In considering the question of freight traffic, he says: "The conditions of greatest economy are reached when trains of a maximum weight are hauled by a single lecomotive. The tendency of late years has been in the direction of increasing the size of the locomotive, the capacity of the cars and the length of the trains. In attempting to carry on traffic of this kind by electrical locomotives operated from a central station, we find that we are at a great disadvantage because of the irregular service necessitated by the freight traffic and the unequal distribution of the load along the line." The station supplying current to any one part of the line would have to have a capacity equal to the total amount of traffic that might be congested on that part of the line and able to support it when required, while the other sections of the line with their costly equipment were idle or partly so. From statistics gathered from a large road he shows that in twenty years the passengers per train mile have decreased from 79 to 59, while the expenses per passenger have more than doubled. Nearly the opposite is true of the foreign traffic, which has more than doubled and the expenses have decreased one-half. The conclusion that he draws is that passenger traffic has come in the direction that electricity is the most economical for transportation, while freight traffic has gone in the direction where electricity becomes most costly.

The general tendency of designers of machinery is toward simplicity, few parts, and these of such form and size as will perform the work, superfluous material being avoided as far as possible. This is especially true of designers of electrical apparatus, which has undergone remarkably rapid changes since its use became general. The date of the design of an electrical generator is usually evident to the expert, when he sees the machine, so marked have been the strides that have been made from year to year. The magnetic and electrical qualities of metals used in the construction of electrical apparatus have been improved as the demand has arisen for greater efficiency. The decline in prices of raw material and improved methods of manufacture have permitted more expensive methods to be employed in the construction of electrical machines. Improvement is always possible even when a perfect result seems to have been attained. The new generators brought out this season show many important changes in their design and construction. The new generator illustrated and described in this issue exhibits the adoption of more efficient material, reducing the size and giving it a more compact form. The higher magnetic capacity of laminated iron and the more uniform quality of the magnetic circuit when so constructed has led to the adoption of this method of construction, which has been generally used in the construction of armature cores. Defective spots which weaken a part of the field are guarded against. Other improvements in minor details are also noticeable.

One of the subjects discussed at the recent convention of the Northwestern Electrical Association was the best size of unit to be selected for central stations, or what proportion of the total capacity of the station should the units represent. There was a considerable difference of opinion shown in the discussion and also a great difference in the selection of the equipment for the various stations of the northwest which were represented. Many of these central stations had been started in growing towns and cities and in a short time it was necessary to double the equipment of the station in order to supply the demand for light. A single generator at first supplied the entire output; soon a second was added and later a third. Additions thus being made as the patronage of the station increased, the equipment was hardly selected with a view to the best size for a station, but rather with a view of supplying the amount of current required. The result has, however, been a number of units of moderate size which enables the varying load of the station to be carried in an economical manner. A single generator alone is run during the period of lightest load and as the load increases another and another generator will be started until under the maximum load all the generators or, perhaps, all except one, will be in use. Thus without any effort in that direction a most flexible and efficient equipment has been secured in these smaller stations. In general the size of station, character of load and prospect of future extension will govern the size of units to be selected. These factors cannot always be determined with any degree of accuracy but should be considered in the selection of the equipment which can in a measure anticipate the future business of the station.

Some Features of the Electric Power Plant of the Chicago City Railway Co.

The electric power plant of the Chicago City Railway, which was but recently completed, although its construction was commenced some three years ago, supplies electric power for the extensive lines of electric railway operated by this company, and also for the operation of one of the cable lines from 39th St. south. It was planned along liberal lines and in accordance with modern ideas in both the general arrangement and the selection of apparatus. If it was the aim of the engineers to produce a superior power plant in every particular, they have succeeded, as the result fully shows. The plant exhibits many important features of engineering practice, and the scrupulous neatness which is shown everywhere about the station shows that the employes take pride in the care of the station.

In the main, the equipment consists of 10 Greene-Wheelock engines, with Hill valvegear in pair form each pair operating one 18-foot drive-wheel, and through this wheel two Westinghouse No. 6 generators so arranged with cut-off couplings, that either or both may be run at will of engineer; 5 complete Hoadley patented compound wind systems of rope transmission; 14 tubular boilers, 72 inches by 18 feet long, with Murphy smokeless furnaces and Murphy stokers; the American system of steam distribution being used in connecting the boilers and engines; and a most elaborate switchboard. All the minor details of the plant have been worked out with as much care and forethought as the more important.

There are three distinct features in this plant which, to a certain extent, can be considered an innovation. We will mention them, not in the order of their importance, but as they would most naturally come to the notice of observers: The valve mechanisms and governor, on which depends largely the efficiency of the engine, are what is known as the Greene-Wheelock-Hill combination. The valves are the gridiron type and both steam and exhaust are located directly under the cylinders with one port at each end.

In place of the valve seats being a part of the cylinder casting, as is usual with other types of engines, both valves are contained in one removable plug, which forms the seat for the valves. This design makes it possible to keep tight joints, as plugs can be removed and seats scraped to a fit, and besides keeps the cylinder constantly drained. These engines under control of the governor will admit steam full seven-eighths of the stroke, which makes it possible, with steam at 100 pounds pressure and running 100 R. P. M. to obtain fully 2,000 horse-power from each pair.

The valves are operated by a shaft parallel to cylinder driven by a rawhide gear on crank shaft. This shaft also drives the governor by a series of miter gears, which makes the governor a positive indicator of the speed there being no loss from slipping belts or other causes between governor and crank shaft. The exhaust valves are operated by eccentrics on the shaft as shown in cut, and is a simple toggle motion.

The steam valves are operated also by eccentrics on shaft, but arranged with releasing gear which is under complete control of governor. The vertical motion of governor shaft is transmitted through the bell crank to a rod running underneath the head of valve plugs, and giving it a longitudinal motion. On this last-named rod are two small hardened steel cones situated one under each plug head. As shown by cut, the eccentric operating the steam valve, is connected with a crank or lever outside of the plug head; on the other end of the shaft to which this lever is connected, and within the plug head, is the pusher, which opens the valve and the steam closes it the moment it is released by the governor. A vertical latch finger passes through the valve stem with square just below the stem. The foot of this latch finger rests upon the loose cone before referred to underneath the plug head. When engine is working, the pusher catches the square of the latch finger and opens the valve. The position of the cone under the plug head governs the point of cut-off, as the least movement of the cone longitudinally varies the contact between the latch finger and pusher plate, releasing the valve earlier or later as the case may be. The governing apparatus of these engines is so sensitive that three-eighths of an inch movement up or down of the vertical governor rod is all that is necessary to operate the valves from zero to seven-eighths stroke. The fact that the governors are positive, and that the least variation of speed

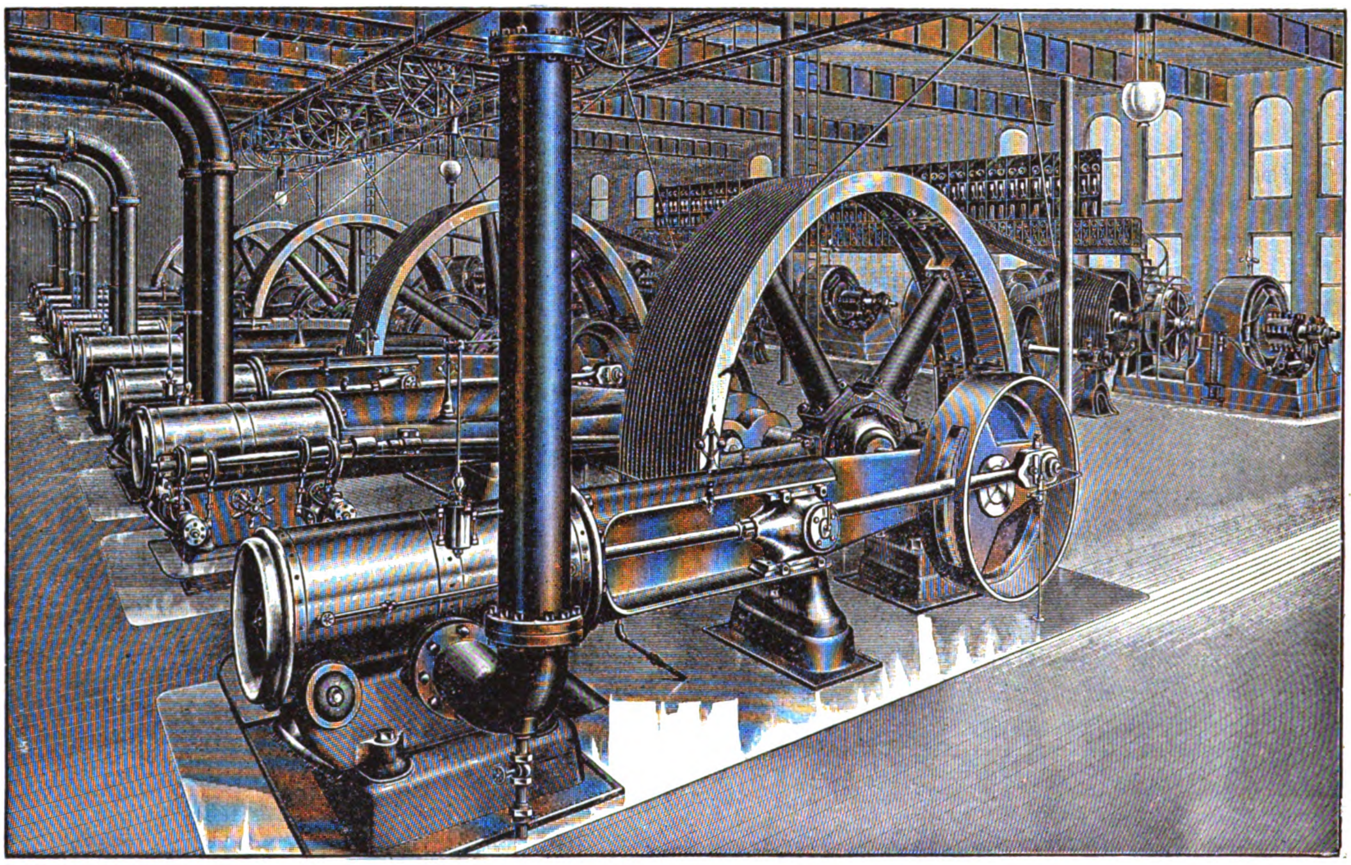

FIG. 1.—SOME FEATURES OF THE ELECTRIC POWER PLANT OF THE CHICAGO CITY RAILWAY CO.

acts so quickly and directly on the valves is the solution of the practically perfect regulation of these engines. The packing throughout is metallic, and the frictional load of engines is exceedingly small.

The Hoadley compound wind system for each pair of engines as used in this plant consists of one 18-foot driver, one 72-inch driver, and one 72-inch compound winder. The drivers are built up, segmental wheels of about 50,000 pounds each and grooved for 21 one and one-quarter inch ropes. These wheels run as true as a straight-edge, and although the rims are in eight segments they fit in place so nicely that one cannot feel the joints.

The driven pulleys are each on short shafts with a cut-off clutch coupling ring on each end of shaft, the clutch mechanism being on generator shaft. They are grooved for 32 one and one-quarter inch ropes. The compound winder pulleys are grooved for 11 one and one-quarter inch ropes, are set at a sufficient angle to transfer the rope one groove, and are placed between the driver and driven pulleys.

The rope is so wound that all the 21 ropes in the drivers pull direct on the driven pulleys, and after doing its work runs over the idlers and the tension carriage above, which takes up any slacks, and keeps all the laps of the ropes of the same tension. The effect of the compound winder is like taking a "snub" around a post, and makes slipping almost impossible, and the loss of power by friction exceedingly small. There is an elasticity in this system which lessens the strain on engine and prevents serious damage to it in case of short circuit or other injury to generators. The average life of these ropes if properly cared for and treated with a suitable dressing, is from five to ten years. This part of the plant was designed by the New England Engineering Co., Hoadley Bros., engineers, Chicago.

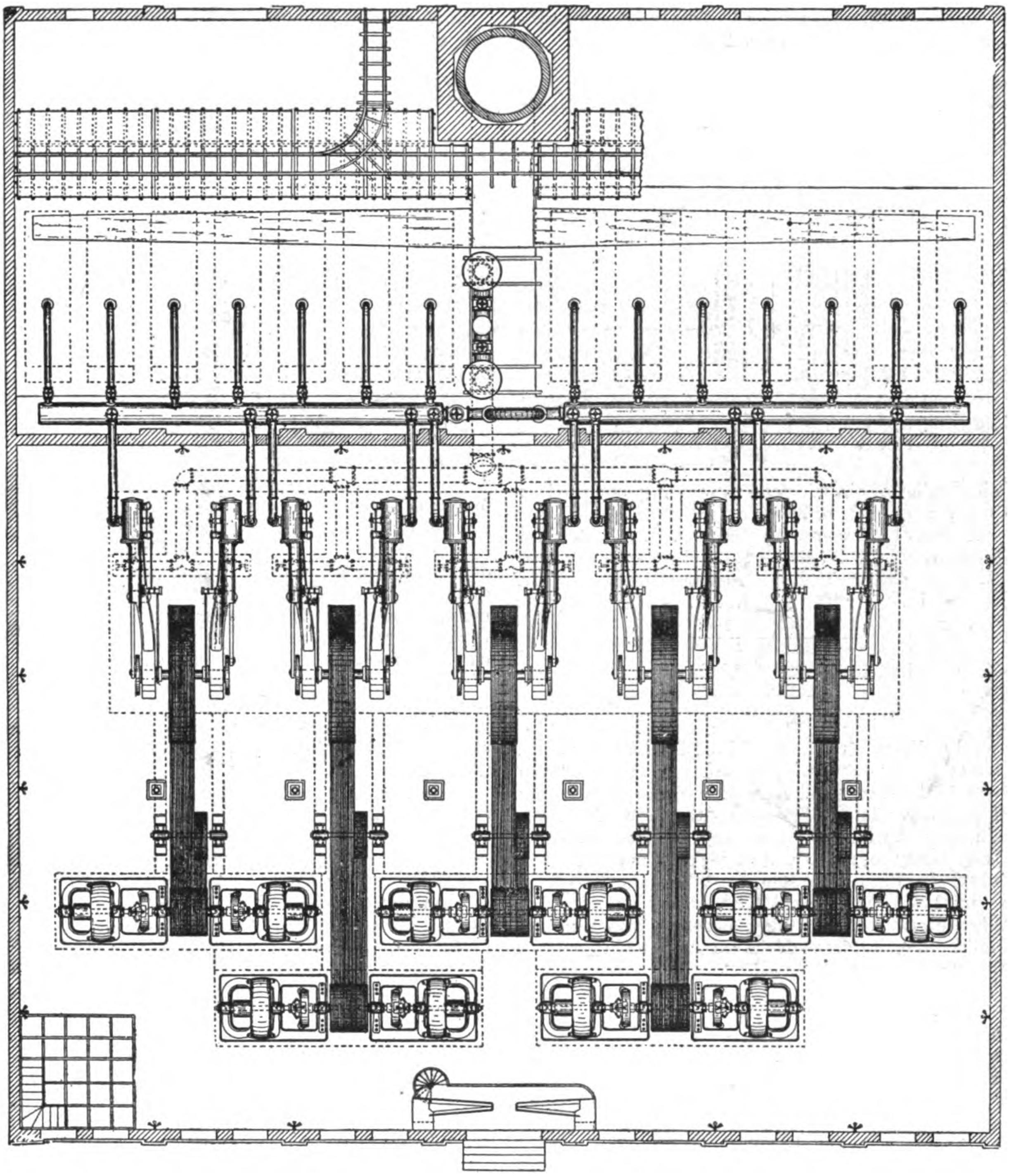

FIG. 2.—SOME FEATURES OF THE ELECTRIC POWER PLANT OF THE CHICAGO CITY RAILWAY CO.—PLAN OF POWER HOUSE.

The method of steam distribution together with the special connections and fittings used are worthy of special notice. The boilers are arranged in batteries of seven each and over each battery there is a thirty-inch header 53 feet long. The two headers are connected by an eighteen-inch copper goose neck. Steam is taken to each of the ten engines by a ten-inch pipe, the elbow being copper and of the form shown in Fig. 3. The system of valves in the pipes leading from the boilers to headers and from headers to engines makes it possible to use as many boilers or engines as necessary without interfering with the operation of the rest, at the same time delivering steam to all the engines in use at the same pressure. As is well known the expansion and contraction of the headers longitudinally is the cause of trouble for the engineer. With the use of ordinary systems this variation in the length of headers causes a lateral motion of the feeder pipes resulting often in continually leaking pipes and sometimes broken ones. With this system the headers are made shorter, and what expansion there is is taken up by the copper elbows. No tests of this plant have as yet been made which would show with any degree of accuracy the efficiency of the plant, yet the results obtained per car mile have been commercially most satisfactory. There are over one hundred miles of electric road now being operated on which there are upwards of 200 cars.

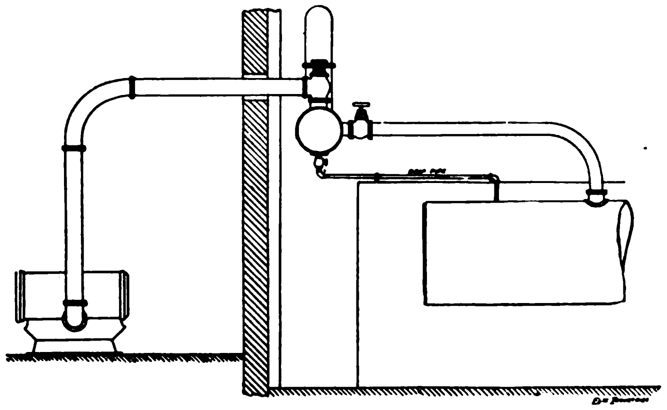

FIG. 3.—SOME FEATURES OF THE ELECTRIC POWER PLANT OF THE CHICAGO CITY RAILWAY CO.

The president of this company is Mr. G. H. Wheeler; the superintendent, Mr. M. K. Bowen, and chief engineer, Mr. Robert J. Hill. This station is under the direction of Mr. Harry Hibbard as engineer, with Mr. J. C. Reilly as electrician.

Electric Street Lighting.*

BY GEORGE CUTTER.

A general uniform illumination of mild intensity such as that of a cloudy day or possibly that of a clear night with a full moon is the theoretical condition to be produced by artificial lighting. This is especially the case after bedtime. There is an illumination better than either of these two for our study to reproduce artificially, and that is a clear night in winter in extreme northern latitudes—that is, the midnight of the land a little south of the midnight sun. When we can produce this general uniform illumination of mild intensity, most desirable in a town gone to sleep, we will then have the best night illumination. But this mild illumination, while it may be best for outlying or residence districts during all hours of the night, is not sufficient for the business center during the earlier hours of the evening. So for proper results we must produce a brilliant illumination of this business center until bedtime, and for the sake of economy, we must then change the down town illumination to the same mild intensity that serves for the residence districts earlier in the evening.

It is the police duty of the light in preventing crime and in facilitating the capture of criminals. But even for this duty a uniform illumination of mild intensity is likely to prove best, because the eye, which is adjusted to a bright light, cannot distinguish objects in a dull light. So the thief or burglar would work with safety in a dark corner, when a few bright spots are used as the lighting system, whereas, the same corner with the same intensity of light would be a risky place to work in when the street lighting system gave a general illumination of mild intensity which would be free of the bad effects of great contrasts of light and shade.

For the same reason, dark alleys should be avoided even at the sacrifice of a uniform arrangement of our lights. There are various points to be considered when we come to the practical side of the question and try to determine what system will give the best approach to the theoretical results with the fewest practical objections. Among those points I might mention a few of the most important: 1. We should consider the means of distribution to produce the nearest to our theoretical conditions; that is, we should aim to procure a uniformity of light even of mild intensity in preference to a few extra bright spots with intervening dark spots. Briefly stated another way, avoid great contrasts of illumination. An exception can be made as before indicated for the business section before bed-time, a brilliant illumination of this section in the early part of the night changing to correspond with the rest of the city for the rest of the night.

2. Reliability of service of the lighting system, since it loses its effectiveness either as a pathfinder or as a safeguard unless it is perfectly reliable.

3. Steadiness of illumination is another point closely connected in importance to the one just mentioned, and in the same line of thought, viz., that of avoiding contrasts in illumination either in different localities or at different times.

4. Determining the last two points bring us to the fourth, necessary skill of all labor and ease of procuring same, the employment of home talent to the greatest extent possible being usually advisable. If the installation and operation of our plant requires special skill, then absence of this skill might cause bad service or even total cessation of light. Many a street lighting system has fallen short merely by disregarding this point.

5. Then there is a durability of the apparatus, together with ease and economy of replacing used-up parts. In considering this we must look out for both the probability of permanency of the supply of duplicate parts and the amount of attention to keep all in good working shape. After careful judging of the closely related points thus far enumerated we can well give attention to the sixth: Efficiency of conversion from coal pile to light. My only comment on this point is that I place it second in importance to that of general uniform illumination, as high efficiency can well be set aside for the other more desirable feature of uniformity. Considerations of this point of efficiency lead to the seventh—total operating expenses, the importance of which depends almost entirely upon local conditions. As also the eighth point, cost of necessary plant for producing the light.

This leads to the ninth—appearance of fixtures on streets and squares, and on this point more attention should be given than is the usual practice. It is not right to have line wires hanging loosely about our streets, the lights arranged along a straigt street in a zig-zag fashion and a general appearance of carelessness throughout the whole work. It costs but little extra attention, and practically no extra expense, to have the lights in a line, the wires straight, fixtures level or plumb as the case may demand. We have means at hand for the installing of arc or incandescent street lights so as to present an attractive appearance. The repair account in a trim and neat plant is always less than in a neglected one. All the help and all the citizens respect the fixtures in proportion to their appearance. What is more, a large share of the opposition to overhead wiring would never have been raised if it had not been for the bungling work which is so common.

During the present year branch lines of the New York, New Haven & Hartford R. R. and Pennsylvania road have been equipped for the use of electricity. These branches are short and have a large passenger traffic so that the conditions are favorable to the use of electricity. The electric railways have taken a large amount of local traffic from the steam roads which the steam roads can hardly regain but by a train service better adapted to local passenger traffic they will be able to retain a greater amount of it. Railroad managers are beginning to study the advantages of electricity for feeder lines, and the coming year will undoubtedly see a large number of steam roads equipping their branch lines for the use of electric power. Several roads centering at Chicago are considering the adoption of electricity on their suburban branches which are now feeling the competition of the electric street railways.

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* Abstract of paper read before the Northwestern Electrical Association.

Lighting Installations in the Early Days.

BY FOREE BAIN.

Sometimes the stories of old times are interesting. The art of electric lighting is numbered in so few years that even an oldest timer may have had an experience of only a few years, which is about the age of the art itself.

In 1879 the Maxim Electric Light Company of New York took the contract to light the exposition building in Cincinnati with arc lights. I was then employed with their western representatives and had charge of the installation. The plant consisted of ten twenty-thousand candle power lamps and ten separate dynamos for these lamps, and seven ten-thousand candle power lamps and seven corresponding dynamos, that is, a dynamo for each lamp.

The dynamos were of the gramme ring type, with wrought iron field magnets, stationary brush holders. The lamps were made almost entirely of brass, and were beautiful in design and finish, but they required new adjustment with each change of the current value.

The dynamos were marked 15 webbers. We hadn't heard of an ampere or a volt at that time.

The circuit consisted of copper wire on one side, and gas pipes on the other side, when they were available. The copper wire was plain and uncovered and was procured of the tinners and hardware stores. There wasn't a piece of even the much-abused underwriters' wire in the United States at that time.

All of the dynamos and all of the lamps were connected in parallel between the outgoing conductors and the gas pipes. It is true the gas pipes did get quite warm, but I thought that that was an indication that the business was working well.

We used the gas pipes because we were short of wire, and as telegraph practice justified this procedure we could not see why it wouldn't work all right with the arc light, and it did.

I did not have a voltmeter or amperemeter; nothing but lamps and dynamo. The plant was run on the principle of by guess and by gosh, but it worked all right and it was a great success.

After the exposition was over for the season, I put one of the larger lamps on a tall pole on the pony track at the Highland house, a fashionable beer garden on the hill, in Cincinnati, where it could be seen from all the surrounding country. I went up to the garden almost every night for a week until the man at the barn felt that he was capable of taking charge of the plant, run the engine, etc. Another man by the name of Mike, had charge of the ponies, carts, etc., but was never called upon to molest the light which illumined his pony track so satisfactorily to him, until one night the man at the barn didn't "show up." Mike waited until time for his light to start up, then he reported to the superintendent, who in turn sent word to Mike to start up the light himself.

Now, Mike had enjoyed the big light every night in blissful ignorance of the fact that there was anything necessary to make it burn except the carbons, the globe and proper starting. It is not necessary to say that he didn't succeed in making the thing " go," although his efforts applied in almost any other cause would have brought success.

The next morning after this eventful night Mike sent for me. "Well, Mike, why didn't your light burn last night?" "Sure, sir, I don't know. I do be thrying to do me part; it's more than the full of a box of matches I spint a-thrying to light thim two black sticks, and dev'l a light could I get." The great pile of burnt matches under the lamp bore evidence of the truth of Mike's assertion.

In the fall of 1880 I installed a Maxim incandescent dynamo, regulator and 60 incandescent lamps in the same exposition building. The dynamo was said to have a capacity for 60 forty-five volt lamps. It was as large as a modern 600 light dynamo; besides, there was used in conjunction with it an exciter about as large as a modern 6 kilowatt dynamo. The lamps were marked from 80 to 85 ohms. I remembered that I arranged them in the order of their resistance, placing those of highest resistance near the dynamo, and those of least resistance at or near the end of the circuits. This circuit consisted of uncovered copper wire on the one side and gas pipe on the other. The lamps had for terminals two platinum wires about one-half inch long each. These I bent into hooks or loops which were hung on two parallel wires, forming a portion of the circuit where it was desirable to place a lamp. The filament of most of the lamps was in the shape of a Maltese cross and a few were in the shape of an M.

In this plant I didn't have a socket, a switch, a piece of insulated wire, a fuse, an automatic cut-out, a switchboard, a ground detector, a voltmeter, an ammeter, nor an inspector's certificate. Yet the plant ran for thirty nights without a "hitch."

A year before this time, in the winter of 1879, before I ever heard of an incandescent dynamo, I got hold of some Maxim incandescent lamps, about ten in number, I was "just crazy" to see them burn, and after giving considerable thought to the matter, I installed an arc dynamo of 15 webbers, energized the fields with ten Bunsen batteries and placed the lamps in parallel in the main circuit and to my delight I was rewarded with a beautiful light. I lighted a hall in which there was held a banquet, with this outfit, but I didn't take time to sample the viands under which the tables were said to have groaned. I was kept busy switching in alternate sets of batteries as they began to show evidence of polarizing, but they held out all right and the lamps were a great curiosity to all who saw them.

And now just one more that will make the salesman's mouth water. In the fall of 1880 I sold to the Grand Opera House Company in Cincinnati one six light (2,000 C. P.) arc light dynamo and lamps for the sum of nineteen hundred and fifty dollars, or three hundred and twenty-five dollars per light. If we could sell a few plants at such prices today we could soon retire.

Annual Convention of The National Association of Stationary Engineers.

The fourteenth annual convention of the National Association of Stationary Engineers opens at St. Paul, Minn., on Tuesday Sept. 3d. The headquarters of the executive committee is at the Ryan Hotel and the convention will be held at the State House. It is expected that the attendance will be unusually large as large delegations are promised from the east and middle states. Engineers from the northwest will not miss this opportunity. The trip to and from St. Paul will be a pleasant one and will enable delegates to see the cities and country along the route.

Every effort has been made by the executive committee to make the convention a success and the visit of the delegates to St. Paul a pleasant one. Arrangements have been made for a large exhibition of devices and steam appliances. Representatives of the manufacturers will be present to take charge of the displays.

The Atlanta Consolidated Street Railway has perfected plans for its terminal at the Wilson avenue entrance to the Exposition grounds. The station will be circular and enclosed within a circular space, the track running around in the form of a loop from the entrance to the exit. This loop will be separated from the Exposition ground by a fence at which turnstiles will be located. Going in on the right of the loop passengers will buy Exposition tickets and pass through the turnstiles. Coming out of the Exposition grounds visitors will buy street railroad tickets and enter doors arranged successively along the platform on the left of the loop. Each door represents a car route, and this will be indicated by signs overhead; all car lines will converge on the Exposition grounds, and passengers returning can take a car for any part of the city. Below the doors of the different car routes is an exit marked "overflow," and when cars for special routes are not full, they will stop at the overflow and take passengers for the center of the city. A terminal station similar to this one will be at the Jackson street entrance and converging on the two points cars will come from every quarter of the city.

The annual meeting of the Street Railway Association of the State of New York will be held at Albany on September 17.

Interesting Effect Observed with the Voltaic Arc.

Two Brianne arc lamps were installed at Havre in front of a jewelry establishment in order to light up, at the same time, both the clock and the interior, and they were to be fed by the alternating current furnished by the central station of the "Havre Electrical Energy Company."

This current had a mean electromotive force of 60 volts, and was derived from a transformer fed by a primary current of 2,400 volts.

This difference of potential of 60 volts being too high to obtain a normal rate of working from a single lamp, and being, besides, too low for working two lamps in series, this difference of potential was reduced to 45 volts by the introduction of self-induction resistances on the secondary circuit, and the two lamps were connected in parallel.

Each absorbed 10 amperes when burning normally. The upper carbons of the lamp had a section of 14 millimetres and the lower carbons of 10 millimetres.

Lastly, these carbons were arranged in the center of a large globe of transparent glass, one-half of which had been silvered inside, so as to become converted into a hemispherical reflector.

The exterior of that part of the globe that formed the hemispherical reflector was covered with an opaque varnish, which completely hid the light on that side.

We have had to give all these preliminary details in order to facilitate the explanation of the curious phenomenon that we are about to describe.

When we made the first trial of these lamps in their reflecting globes, they worked at first very regularly, furnishing a satisfactory light for lighting the clock and the shop; but, after about half an hour, there was a sudden brief extinction of each of the two lamps, to which, at first, no great importance was attached.

But half an hour later another extinction occurred, followed, as before, by the immediate relighting of the lamps.

On examining the carbons, we were surprised to find that they were considerably reduced in length; it was evident that this abnormal combustion was far from being in proportion to the duration of working. The lamps were put out, and at the bottom of each globe were found two little spindles of graphite, about 4 centimetres long, pointed at one end and hollowed at the other (Fig. 1).

The presence of these spindles readily explained the cause of the apparently very rapid combustion of the carbons, and the successive extinctions of the arcs; but the cause of their formation seemed, at first, inexplicable.

In order to ascertain the cause of this curious phenomenon, the lamps were made to work again several times in succession, their voltage and amperes being modified; but after each fresh trial four fresh spindles of graphite, exactly similar to the first, were found.

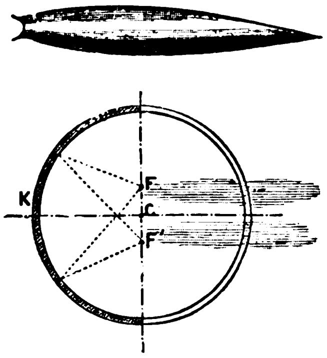
On studying this phenomenon more closely, we soon found out the couse of this abnormal combustion. In fact, the carbons occupied the center of a hemispherical reflector, K (Fig. 2), and, at the moment of lighting the focus made by the axis, was formed at a point, F, situated above the center, C, of the sphere.

A corresponding focus was then formed by reflection at F, and the lower carbon.

The result of this was that the greater part of the luminous and calorific rays were concentrated at the point, F′, and that the luminous focus, F, did not give out more luminous intensity than if it had burned with a naked light. The heat concentrated on the lower carbon soon became so great that the carbon became red hot, and began to be consumed at this point. The section of the carbon was consequently lessened by this combustion, the heating produced by the passage of the current in this resisting part was added to that furnished by the secondary reflection; and soon the section was reduced to a single point of contact, through which the arc was formed. At this moment the spindle became detached, and fell to the bottom of the globe in an incandescent state.

After the extinction produced by the separation of the spindle from the principal carbon, the action of the regulator brought the carbons in contact again, and the arc was again formed; but this time the arc was formed at F′, at a point below the center, C, of the sphere. A corresponding focus was then formed at F, and soon a second spindle detached itself from this carbon, and fell to the bottom of the globe by the side of the first.

When once the cause of this defective working of the lamps was known, it was easily remedied. In fact, the reflecting globes were abandoned, as they were found to have such a disastrous effect, and they were replaced by cylindrical reflectors with parabolic section. The lamps were arranged so that the carbons occupied, with regard to the reflectors, an axis parallel to the generators of the cylinder, and passing through the focus of the parabola. As the luminous focus was variable, we thus arrived, by a simple method, at a system of lighting which was to all intents constant during the whole of the time that the lamps were in service.



FIGS. 1 AND 2.

The result of this alteration was a considerable increase in the light projected and the absolutely regular working of the lamps.

In conclusion, therefore, we will advise all those who wish to use a reflector for an arc light never to arrange the luminous focus at the geometrical center of a spherical reflector; but we may add that there would be no objection to placing this luminous focus at the optical focus of the reflector, i e., at a distance from the top of the hemisphere equal to half the length of the radius of the sphere, so as to project the rays in a luminous sheaf to all intents cylindrical.—From L'Electricien, reprinted in London Elec. Review.

Eleventh Annual Meeting of the Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating Companies was held in Detroit August 13, 14 and 15. The meeting was called to order by the president, Mr. C. L. Edgar, and the roll-call showed a good attendance. Among the papers read and discussed were the following: "The Relations of the General Electric Co. to Edison Licensee Companies." "Some Comparisons Between the Direct Current Low Tension System and the Alternating Current and Multiphase System for Central Station Lighting." "Energy Losses in the Boston Edison Station." "Method of Charging for Current for Incandescent Lamps and Motors," and "Facts in Relation to Mechanical Recording and Chemical Meters." The next convention is to be held in Brooklyn or vicinity the second Tuesday in August, 1896.

American Electrical Works' Clambake.

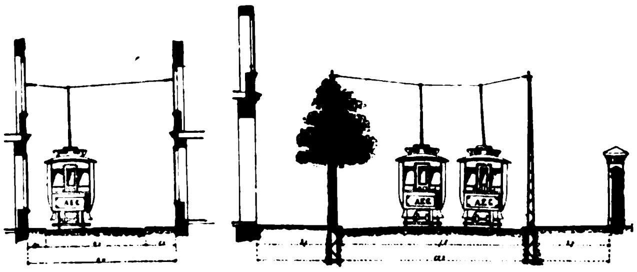
The annual outing tendered the electrical fraternity by the American Electrical Works is eagerly looked forward to each year. This year the seventeenth outing was celebrated and also the twenty-fifth anniversary of the establishment of the American Electrical Works, on August 17. Mr. Phillips, the president of the company, is one of the pioneers in the manufacture of insulated wire and is familiar with the growth of the industry and the men who have been identified with it. His friendship for them is nowhere better shown than in these annual gatherings. The variety of games that were prepared at Haute Reeve were participated in by nearly all present, so that when they sat down to dinner, nearly 200 strong, no one lacked a hearty appetite.

Annual Reunion of Old-Time Telegraphers.

The fifteenth annual reunion of the Old-Time Telegraphers' and Historical Ass'n. is to be held in New York September 11, 12 and 13. The meetings are to be held at the Broadway Central Hotel, opposite Bond St.

The Electric Railway at Essen.

The electric railways of Europe are constructed very much like those of America with the overhead trolley wire and the track for the return part of the circuit. Storage batteries and the underground trolley systems have been tried, but for several reasons the overhead system receives the preference. The conditions to be met in many of the streets of the European cities are in some respects different from those to which the American engineer is accustomed, but in the main the systems are quite similar. The advantages of the electric railway for urban and suburban transportation are fully appreciated, and its adoption has been rapid since electric power demonstrated its claims for consideration.



FIGS. 1 AND 2.—THE ELECTRIC RAILWAY AT ESSEN.

The history of the use of the storage battery on railway systems in Europe is quite similar to its history on this side of the Atlantic. From a financial point of view they have not been a success. The great amount of care demanded by the equipment was one of the disadvantages. The rolling stock and equipment of a successful system must be capable of severe usage and require the minimum amount of attention.

The underground systems have been more successful, and while more expensive to construct, and require more care to maintain than the overhead, it meets the requirements of some cities which are prejudiced against the overhead construction. Many of the objections to the overhead trolley railways have been removed by the use of a lighter but more substantial overhead construction, and it is now the favorite system in Europe. Among the prominent roads, that of Essen possesses many features of interest. This road was installed by the Algemeine Elektricitats-Gesellschaft of Berlin, and equipped with their apparatus throughout.

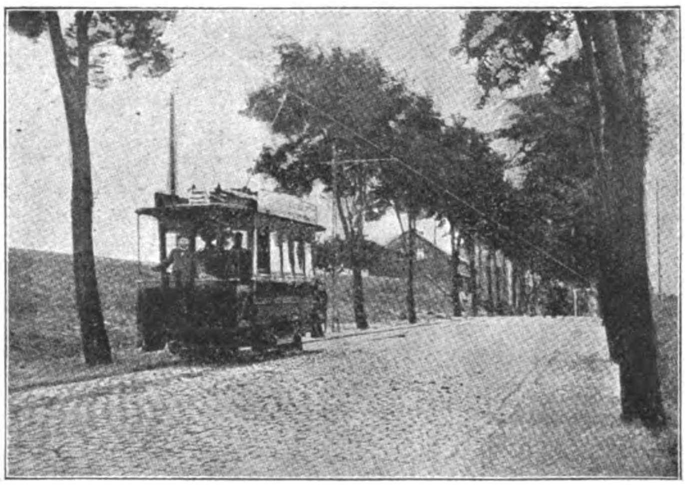


FIG. 3.—THE ELECTRIC RAILWAY AT ESSEN.

In the construction of this road many difficulties were met and successfully overcome by the engineers of the company. The narrow streets and steep grades were by no means easy problems, but these were with very little difficulty equipped for the operation of the electric cars. It was found that on these narrow streets the electric cars took up less room than the horse cars, and were controlled with greater accuracy. The stopping and starting must necessarily be under the perfect control of the driver, and the speed of the car must often be regulated to that of the traffic on the street. On these points the electric car seems unrivaled. On the outlying streets great freedom was allowed in the construction, but very neat and light poles were used, which do not mar the beauty of the street. In the narrower streets of the city the width of the streets did not allow the erection of poles, and the cables which support the trolley wires were fastened directly to the walls of the buildings. Thus, even in the narrowest streets the electric cars do not make the street more crowded, but on the contrary less crowded than with the horse cars. As a matter of safety the records of this road show very few accidents, and it is believed that the change to electricity has not in any degree increased the number of accidents. The driver has his car under his control, it starts as he directs it and stops within reasonable limits when he so desires. In passing through crowded streets his view is not obstructed by the team of horses in front of him, and he can give his entire attention to the track and the street traffic.

The trolley wire used on this road is a silicon bronze wire which, while having approximately the same conductivity as copper, has greater firmness. The span wires are placed about 40 yards apart, except on curves. The poles are of the latticed pattern of iron poles and are set inside of the curb. A single line of poles with brackets is used where the track is at the side. These come in line with the shade trees as shown in Figs. 2 and 3. In Fig. 1 is shown the practice in narrow streets which will not permit poles to be erected, the trolley wire being fastened about 18 feet above the track.

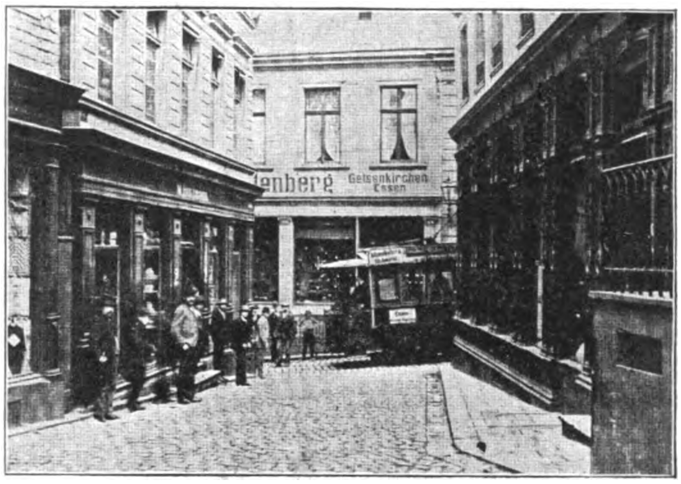


FIG. 4.—THE ELECTRIC RAILWAY AT ESSEN.

The rolling stock as shown in the accompanying illustrations differs little from the average American cars. The motors are of the four pole type and are suspended in a manner which gives an easy carriage. The armature is geared to the axle by a simple wheel gear which is entirely enclosed. The field magnets are constructed of a form that entirely encloses the armature and thus protects the working parts from dust and mud.

The cars are lighted by incandescent lamps, run five in series, the potential used being 500 volts. The controlling devices are placed on the platform of the car where they are conveniently located for the use of the motorman. This road has 13 miles of track and operates 24 motor cars and 17 trail cars. Some of the streets through which it runs are only eleven feet eight inches from curb to curb, and but thirteen feet four inches between house fronts. There are also numerous grades on the lines which require an extra strong equipment.

"I think you publish the best electrical paper there is. I am more than pleased with it and I have made it a point to recommend it to my friends." A.D. Hill, Lawrence, Kas.
Lawrence Gas, Elec. Lt. & Fuel Co.

The American Electro-Therapeutic Association holds its annual convention at Toronto, Canada, on the third, fourth and fifth of this month.

Notes on the Reconstruction of a Small Central Station Plant.*

BY FRANKLIN L. POPE.

The financial condition of the smaller central station electric lighting plants throughout the country is at the present time by no means satisfactory, and in too many instances cannot even be truthfully said to be encouraging. A survey of the field shows that very few such plants located in towns having less than 10,000 inhabitants are earning more money than is necessary to meet their operating expenses and to provide for indispensable current repairs. In the State of Massachusetts, in which the operations of all electric lighting companies are by law made a matter of public record, it appears from the latest reports that the aggregate liabilities of the 57 companies operating in that State, including stocks, bonds, and floating indebtedness, amounted on June 30, 1894, in round numbers to $14,000,000, nearly all of which stands charged to construction account. The net earnings for the preceding year were $1,000,000, or about 7.1 per cent. on the total investment; a sum obviously quite insufficient to provide for depreciation and at the same time pay a fair dividend on the capital which has gone into the business. But if half a dozen of the larger plants, in cities like Boston, Lowell, Worcester, Springfield, Lynn and Fall River were excluded from the list, the showing for the smaller plants would be even far worse than it now appears.

Many of these small plants were started at an earliear day than could have been justified by any reasonable estimate of the business then in sight, and now find themselves hampered by inconvenient buildings, and with unsuitable machinery bought at high prices, and encumbered with defective business methods which experience has shown to be wholly inconsistent with the dictates of good judgment.

With the owers of many of these plants, it has become a very serious question whether the easiest way out of the dilemma which confronts them may not be to relegate the entire plant to the junk shop and the scrap pile, and commence over again with new buildings, modern machinery and improved methods of administration. When the necessary capital is readily forthcoming, there can be no doubt that this would often be the wisest course of procedure, but for obvious reasons, it is one which is not always, nor even usually practicable. The alternative is to remodel the existing plant, bringing it as nearly as may be into accordance with the best modern practice, and utilizing so far as possible the old material; a course which at least has the merit of avoiding an undue expansion of the construction account, in most cases already sufficiently burdensome.

Having been called upon during the past year to advise the owners of a plant of the character above referred to, in reference to certain changes which had been suggested as desirable, and having afterward been employed in a professional capacity to design the work and superintend its execution, I have thought that some account of what we undertook to do and how we did it, might not be without interest to the members of the Institute.

[The plant of the Great Burmington, (Mass.,) Electric Light Co. was here described, formerly operated by a combination of engines and water power, but remodeled under the author's supervision, and placed upon a more substantial basis, an abundance of water power being now leased at a certain amount per kilowatt generated.]

In carrying out this work, some things have been learned by experience which may be of use to others called upon to advise or to undertake the construction of similar works, and I will therefore venture to summarize some of my conclusions as follows:

1. In considering the advisability of operating an electric plant by water-power, do not on any account neglect to ascertain from authentic sources of information, just how much water can be depended upon during the low stage in an extra dry year, for this is the measure of its value for electric work, except when used as an auxiliary to steam. The ordinary estimates of the commercial value of a water-power are only too apt to prove preposterous exaggerations.

2. If rights-of-way or releases of damages can be obtained without too much trouble and expense, it is better to build the feeder line as directly across country as may be, than to follow a highway. The saving in cost of construction will usually be more than enough to pay for the right-of-way, and on such a route there need be no interference from trees, while many inconvenient angles and much trouble in guying and bracing are avoided. Shorter and stouter poles may also be used; in itself a very important consideration.

3. In electric line construction it is preferable to dispense with cross arms unless there are more than six wires. The best arrangement is to place one wire on a top-pin and the others alternately on the front and back of the pole, at a vertical distance apart of 12 inches. This construction not only costs less than properly braced cross-arms, but is much less conspicuous and therefore much less objectionable in a public street, is less interfered with by trees, and is far more durable. Much trouble is caused by the decay of cross-arms after they have been exposed a few years to the weather; they split at the ends so that the pin comes out, and not infrequently break in two in the middle thus fouling the wires.

4. In medium-sized towns and cities, especially in shaded streets, the incandescent lamp may be made to give a better distribution of light for the same money than is possible with the "half arc" so extensively used, and is much less troublesome to maintain in good working order. My own experience leads me to think that the lamps ought not to be of less than 24 or more than 32 candle-power. Use lamps of low rather than high efficiency, but run them at full candle-power, or even a trifle above. Good street lights, well arranged, and renewed sufficiently often, are the best possible advertisement for any electric company.

5. Use large transformers as far as practicable, placing the consumers within 500 or 600 feet radius upon secondary mains. We have used both two-wire and three-wire mains. The latter plan is certainly to be recommended when the distance approximates or exceeds 500 feet, but for short distances, as for example when distributing within a single block at a pressure of 100 volts or more, it is a question whether the gain in cost of copper over the two-wire plan is of sufficient importance to offset the additional complexity.

6. It was found that raising the voltage in the residence district from 1,000 : 50 to 2,000.: 100 greatly improved the uniformity of distribution, by lessening the potential drop without entailing any corresponding disadvantages. It would seem to be preferable, on every account, to use the higher pressure.

7. One of the most important minor points in the management of a plant is apt to be too much neglected: the maintenance of the insulation of the wires by promptly replacing all cracked and broken insulators, and by keeping the wires absolutely free from contact with uninsulated objects. The covered wires which lead into the hoods of the street lamps need to be carefully looked after.

8. Number all the poles with yellow paint applied with a stencil on a black ground; and keep a record book of the position of each one and its distance by the line from the test-station.

9. In selecting a turbine-wheel, consult competent authorities as to the available fall and minimum quantity of water, and when making the purchase do not expect to get a $1,000 wheel for $100. Pay a fair price and insist, not only that the wheel shall be well made in every way, but that it shall be tested by an expert before acceptance. If it does not give an average efficiency of 76 per cent between half-gate and full-gate, it is not advisable to accept it, inasmuch as you can easily do better, as our own experience proves.

10. I think our experience shows that it is possible to largely increase the net earnings of an old plant without necessarily renewing it throughout, but plenty of time should be taken for considering as well as for execution, in order to secure satisfactory results with a moderate expenditure.

Electric power is to be introduced at the government printing office, taking the place of the present mechanical systems of transmission.

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* Abstract of paper read at the Niagara meeting of A. I. of E. E.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles that will be published are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. The articles will be written in plain language and in such a manner as shall make them clear and interesting to all. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

The Wheatstone Bridge.

In the measurement of resistance the Wheatstone bridge is the method most readily used although other means are frequently employed. This apparatus, which is very simple in construction, is almost invaluable in electrical work. Its construction is a combination of resistance coils, a galvanometer, a battery or other source of electric current and that of which the resistance is to be measured. It is largely used for testing and measuring the insulation resistance of electric conductors. The arrangement of circuits and instruments of the Wheatstone bridge is illustrated in the diagram, Fig. 1. The battery or source of electric current is represented by the light and heavy lines at the bottom ot the diagram with the circuit running along the lines representing the electrical conductors. From A to B there are two ways by which the current can pass, by way of C or by way of D, between which two points there is a cross conductor in which is connected the galvanometer, G.

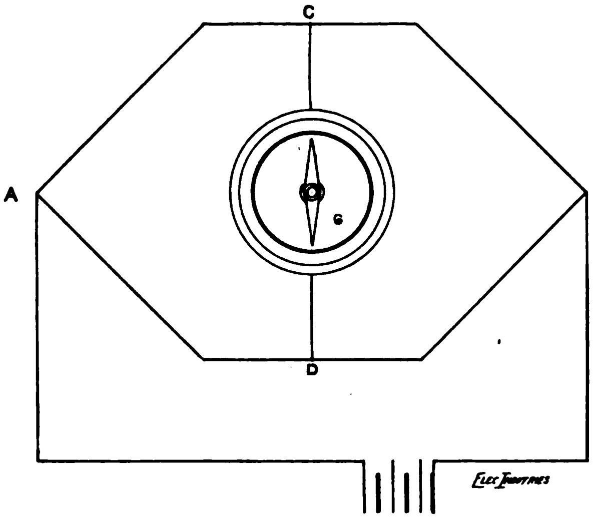

FIG. 1.

When two paths are open to the passage of a current of electricity, it is a well-known fact that the current will divide between them in a proportion inversely as the resistance, that is, if the resistance of one path is twice as much as the other, the current flowing along that path will be one-half as great as the current flowing along the other path or one-third of the entire amount. In the arrangement shown in this diagram there are really four paths between A and B since the current can go through the wire in which the galvanometer is shown passing either from C to D or D to C, but if there exists no difference of potential between these two points, C and D, there will be no current passing the galvanometer. In the use of the bridge, however, we are not directly concerned with the amount of current but only with the difference of potential as indicated by the direction of the current.

The fall of potential along a conductor is proportional to its resistance. If the resistance is great, there will be a corresponding great difference of potential. The reverse of this law is also true, that the resistance is directly proportional to the fall of potential that takes place. Thus if we find a considerable difference of potential between two points on a conductor we may rightly infer that the line has a considerable resistance between those points.

By a simple calculation* the relation of the resistances in the different parts of these two paths to maintain a balance or no difference of potential at C and D, is shown. Suppose we place in the four parts of the circuit resistances, either resistance coils or greater lengths of wire as indicated in Fig. 2. The resistance of A C must be of the same proportion to A D that C B is to D B. That is, if resistance of A C is twice A D, C B must be twice D B, to maintain the balance that is, such a condition of the circuits that no current will pass G.

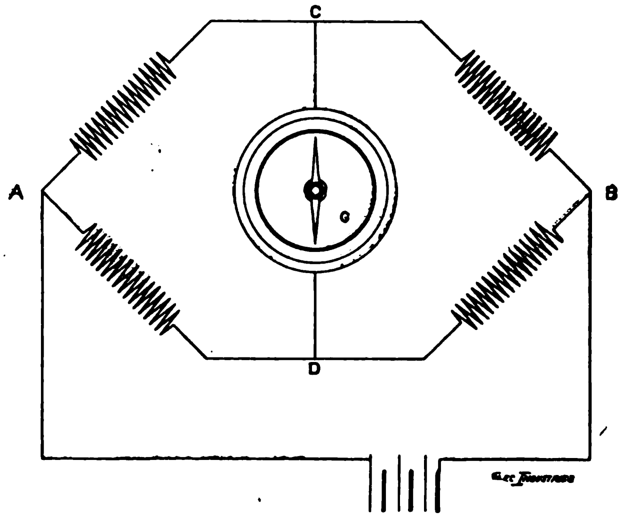

FIG. 2.

Since we know this proportion we can find the resistance of any of the four parts if we know the other three. Thus if we know the resistance of A C, A D and D B we can find the resistance of C B by multiplying the ohm resistance of A C and C D together and dividing the product by the resistance of D B. The result will be the resistance of the part C B. If, therefore, it is desired to find the resistance of a piece of wire or other material by connecting it between C and B and placing between the other parts of the circuits such known resistances as will create a balance between the two paths and perform the calculation as indicated above, we will have for a result the resistance of the metal desired expressed in ohms.

For convenience as well as greater accuracy in measuring resistances the bridge or balance is constructed of a compact form. In Fig. 3 is shown a diagram of the top of a bridge largely used. The resistance coils are compactly arranged in a case in which is placed also the galvano-

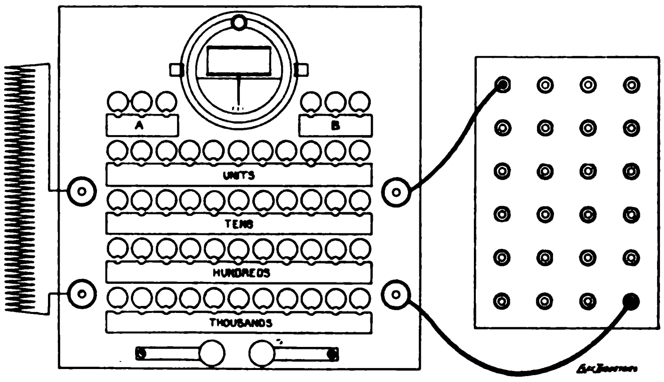

FIG. 3.

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*Suppose the arrangement of the wires of this combination, Fig. 1, is such that there is no current passing the galvanometer the fall of potential on A C B will equal the fall of potential on A D B. By ohm's law E=C R. Let X represent the current flowing by A C B and Y the current flowing by A D B. Let M represent the difference of potential between A and C which is equal to that between A and D, and N the difference of potential between C and B equaling that between D and B. Then M = X A C, A C representing the resistance between those two points. Also M = Y A D, therefore, X A C = Y A D or $\frac{AC}{AD} = \frac{Y}{X}$. N = X C B and also N = Y D B, then X C B = Y D B or $\frac{CB}{DB} = \frac{Y}{X}$. $\frac{AC}{AD}$ also equal $\frac{Y}{X}$ therefore $\frac{AC}{AD} = \frac{CB}{DB}$. It is evident from this that $CB = \frac{DB,\ AC}{AD}$.

meter. Binding posts are placed at convenient points for connecting the battery and the ends of the circuit to be measured. Sometimes the battery is contained in the same case. There are a great variety of forms on the market adapted for the variety of service in which they are used.

The diagram shows the connection of the battery and of the conductor, the resistance of which is to be measured. At A and B., to the right and left of the galvanometer will be noticed the contact plates of three resistance coils corresponding to the resistance in the parts A C and A D, Fig. 2. The remainder of the box is taken up with resistance coils of several sizes as marked, which can be connected in the part corresponding to D B, Fig. 2. Thus there is a row of unit coils, then a row of ten ohm coils, of one hundred ohm coils, etc. If we place a plug in the second hole of the hundreds row we connect in a resistance of one hundred ohms; if in the third hole two hundred ohms, a plug in the first hole simply connects from the lower contact plate to the upper without any resistance. If we place another plug in the fifth hole of the tens we shall connect in fifty ohms more, making two hundred and fifty ohms. The total number of ohms resistance is 11,110, which would be, were it not for the resistance in the other parts of our circuits at A and B, the total amount we could measure with this bridge.

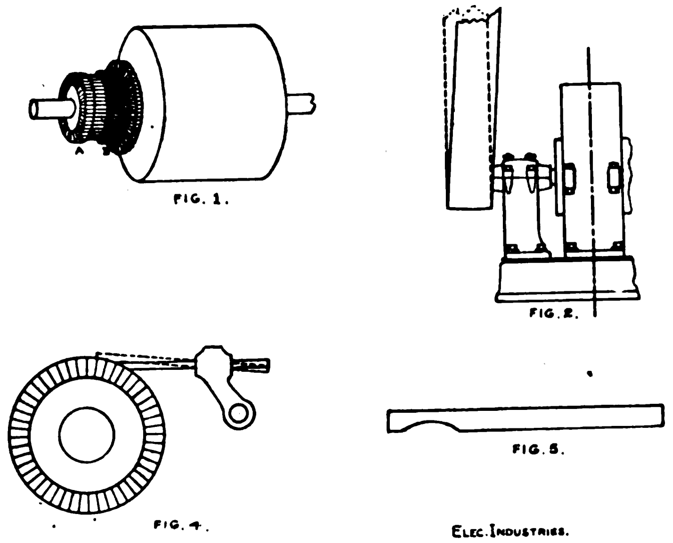


FIG. 1. FIG. 2. FIG. 4. FIG. 5. ELEC. INDUSTRIES.

WRINKLES IN ELECTRICAL PRACTICE.

Since A C sustains the same relation to A B that C D sustains to D B, if we connect 10 ohms in the first coil at A and the same at B, the resistance of the conductor to be measured will be equal to the amount of resistance connected in circuit to create a balance. If, however, we connect in 10 ohms at A and 100 ohms at B, their relation will be as one is to ten, and as D B and C B (Fig. 2) have the same ratio if it requires 1,000 ohms to balance the bridge, one ohm of D B is as 10 of C B, so we shall have to multiply the resistance of our bridge by 10 to get the resistance of the conductor we are measuring. This will give us ten times one thousand ohms or 10,000 ohms. By this method the capacity of the bridge reaches 1,111,000 ohms. It will also measure as low as a hundredth of an ohm, by connecting at B 1,000 ohms and at A 10 ohms which will give the resistance of the conductor measured one hundredth of that on the bridge, the lowest of which is one ohm.

Were it desired to measure the insulation resistance of a conductor, one end only would be connected to the bridge. To the other binding posts a wire making a good ground connection should be attached. Since with a rise in temperature the resistance coils increase their resistance, it is undesirable to have a current passing through them except for very short periods. The circuit is therefore left open at the spring contacts shown on the lower part of the bridge which close the circuit only when the buttons are pressed down by the fingers. By this arrangement the circuit can be closed while the position of the needle of the galvanometer is noted and opened while the plugs are changed.

Wrinkles in Electrical Practice—IV.

BY ALBERT SCHEIBLE, M. E.

Gouging of commutators.—Nearly all of the trouble caused by dynamo and motor brushes can be avoided by using a little extra care and plenty of common sense. Still there are a few "wrinkles" connected with both the brushes and the commutators which ought to be more generally known. The brushes serve merely to convey the current from the segments of the commutator to the terminals of the machine, and as they are usually designed of ample size only a light pressure of the brushes on the commutator is required. Of course it must be firm enough to avoid having the brushes leave the commutator in case the machine gets a sudden jar, but if the pressure of the brushes is made still greater it will cause an undue wearing of both the brushes and the commutator. Indeed, I have seen cases where the excessive pressure of the brushes produced considerable friction and friction always means wasted energy.

Now the brushes are always narrower than the commutator segments and if they bear continually on the same place they will gouge out a part of the commutator just equal in width to the brushes (see Fig. 1). Some dynamo-tenders try to remedy this by shifting the brushes slightly sideways everytime they set them, but that is proper only in machines built with no end-play for the armature. All properly built machines, whether dynamos or motors, have a perceptible amount of end-play for the armature so that the commutator can move back and forth under the brushes to distribute the wear. The amount of this end-play varies from a sixteenth inch to a quarter inch, according to the type and size of the machine, and the maker's part in the matter usually ends there. Then it is the duty of the dynamo-tender to see that the machine make use of this end-play. If it does not do so, there will be a gouging of the commutator and the trouble will usually be traced to the belting. Thus in Fig. 2, the belt is out of line in such a direction as to draw the pulley towards the machine and prevent the ready end motion of the armature. Of course the belt might slant in the other direction with equally bad results, as there would be a gouging of the commutator in either case. If the belting is properly in line we can usually see the armature wobbling endwise, or if we push either end of the shaft with the finger tip the armature ought to move readily. If it does not, then our "wrinkle" for the cure lies in twisting the machine so that the belt runs just parallel to the edge of the pulley. Usually the edge of the base plate is also just at right angles to the shaft, so we can line up the belt by this. It will then give no end-pull to the armature, but the little twisting due to irregularities in the belt will cause the armature to move back and forth so as to distribute the wear on the commutator. The dotted lines in Fig. 2, show the edges of the belt as they ought to appear when properly lined up.

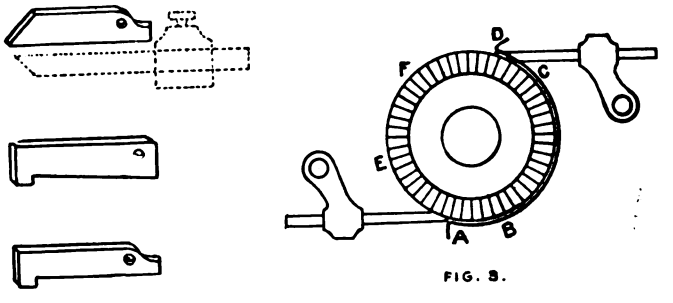


FIG 6. FIG. 3. ELEC. INDUSTRIES.

WRINKLES IN ELECTRICAL PRACTICE.

Jigs for setting brushes.—When a machine has been properly designed and is not overloaded, there should be little or no sparking at the brushes when these are properly set. I have already mentioned one point about setting brushes, namely, that of having them press lightly but firmly on the commutator. Another very important point consists in so placing the brushes that they make connection with the commutator segments connected to coils in the neutral or current—reversing part of the field, and these segments are usually just opposite each other on the commutator. The setting is almost always left to the judgment of the attendant who slides the brushes back and forth in the holder and then shifts them along the commutator surface until he finds a point which he takes to be "about right." Usually it is "about right," but the minimum of wear and tear on both the commutator and the brushes can only be obtained when the setting is "just exactly right."

One method of finding out whether or not the tips of the brushes are diametrically opposite each other consists in measuring along the surface of the commutator from the tip of one brush to the tip of the other. Then the distance A B C D should be equal to that measured along A E F D (see Fig. 3). A paper strip should be used for this; string will not do as it is apt to stretch. This method allows us to make sure of having the tips opposite each other, but it will not necessarily insure a proper setting. Thus if the shaded brush as shown in Fig. 4, is properly set, the one shown in dotted lines would not be right, although it might be opposite its mate. Ignorance of this fact sometimes shows itself in cases where the brushes are allowed to project much too far from the brush-holder so that the wear comes back of the tip instead of coming on the tip itself. Then the brush will wear as shown in Fig. 5, until the tip finally breaks off. To avoid any trouble from such a setting of the brushes we ought to know the exact distance which the brush should project beyond the holder. This is really a point in the design of the machine and it would be easy for the makers to specify this measurement, but it is not so easy to measure it with a rule every time the brushes are trimmed or moved forward. The proper "wrinkle" lies in having a "jig" for setting the brush. This can be easily filed out of hard rubber or sheet fibre. If there are a number of machines of different sizes or types, the jig for each can be plainly marked and the whole set strung on a chain or a piece of heavy twine. Then the bunch of jigs will be less likely to be lost or mislaid than the single loose ones would be. Fig. 6 shows three different shapes of jigs as suited to different machines. It also shows in dotted lines the method of applying such a jig to the brush-holder when making the setting.

The Fresno, Cal., Electric Power Transmission System.

An interesting long-distance power transmission plant is in course of construction at Fresno, Cal., which is unique in more than one particular. The head of water to be used is 1,410 feet, and the distance of transmission about thirty-five miles. The natural conditions surrounding the installation are extraordinary in themselves. The water for supplying the power is taken from the North Fork of the San Joaquin river, their confluence. The stream of the North Fork runs for several miles down a rocky canyon, forming rapids and cataracts as it runs between the steep mountains. At the head of the rapids a canal will take the water out upon the summit of a high ridge, which it will follow for six miles to a point nearly fifteen hundred feet above the San Joaquin river. Here a reservoir has been constructed with an average depth of ten feet. It covers about eight acres and can be made both larger and deeper, should the demand for power require an extension. Into this reservoir, the water brought along the ridge by the canal will be stored, but it will be used solely as an emergency store. It is calculated that it will hold enough water to drive the machinery for several days, so that should a a break occur between the reservoir and the source of supply, the electrical work could continue until the repair was effected.

A pipe line runs directly from the canal, a distance of about four thousand feet, to the power house and the head of water obtained will not be less than 1,410 feet. The pressure at the bottom will be six hundred lbs. to the square inch. The lower end of the pipe line is of welded steel pipe, three-quarters of an inch in thickness, having special steel flanges and special packing at the joints. The lowest amount of water power available, is at least 7,000 horse-power at the head above mentioned. All possible accidents are provided against. Should a break occur near the lower end of the pipe the rush of water would form a vacuum near the upper portion of the pipe and it might collapse under atmospheric pressure. An air valve will be placed near the top to provide against this contingency. The pipes will be made in sections of twenty feet each. At the upper end the metal will be one-quarter inch thick and the pipe 24 inches in diameter. It will be fastened to the solid granite mountain sides by steel cables.

The power station will be located at the bottom of the mountain, and will contain three Pelton water wheels 58 inches in diameter, driven by a single nozzle. The generating plant will consist of three 340 kilowatt General Electric Company's three-phase generators. The three-phase system has been selected in this case as the system which will give the highest efficiency of transmission with the lowest cost of copper.

From the point in the North Fork of the San Joaquin river, where the water is taken to the power house at the foot of the mountain, is a distance of about seven miles. From the power house to Fresno, where the electricity will be utilized, is about 31½ miles in a direct line, or 35 miles over the electric wires. The line will consist of two circuits of bare copper wire, consisting of six wires strung on poles forty feet high. The current will be delivered to the lines at a voltage of 11,000 volts. From the power house the line will rise to the level of the San Joaquin, cross it and pass through a portion of the Auberry valley, then rising over the Red Mountain, passing about a mile west of Clovis will continue direct on to Fresno. The first five miles will be over moderately level country, the other thirty through an open and practically level country, under ideal conditions for transmission. It is estimated that the power which will be delivered in Fresno at present from the three-phase generators will not be less than 900 horse-power.

At the Fresno end the line will be brought into a sub-station and the current will be transformed down. From the sub-station power will be delivered to all the mills in town, the water works, machine shops, planing mills, laundries, printing presses, elevators, packing-houses, etc. It will also be used to drive the street railway system of the city, which will require about 300 horse-power. In the sub-station, two-arc dynamos, each of 60 lamps capacity, will be driven by an induction motor, the motor being mounted on the same bed plate as, and being direct connected to, the dynamo. Current will be supplied for 4,400 incandescent lamps.

Gas and fuel in the San Joaquin valley has always brought an extremely high price, and this may be considered as the most potent reason for the present installation. It is believed that power can be supplied, when the plant is started, at about half its present cost; and to the towns around Fresno the privileges of electricity will probably be extended as soon as possible. This plant may easily be considered as taking the lead in the use of a high head of water and the distance over which the power is transmitted.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion, but must possess sufficient merit.]

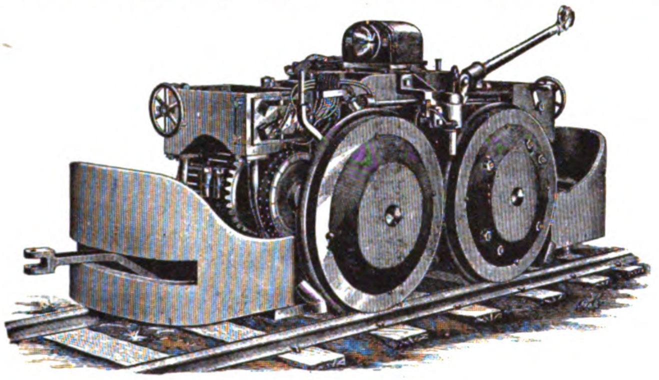
The Independent Mine Locomotive.

Electricity has been utilized most successfully in many of the mines of both the east and west. The coal veins usually lying in a nearly horizontal direction are best adapted for the use of electric coal mining machinery and also for the use of the electric mine locomotive. In the accompaning cut is shown a locomotive of the "Independent" type, and now in successful service at the mines of the Essen Coal Company, located about 12 miles from Pittsburg. These locomotives are of 80 horse-power and will pull a train of 30 or 40 loaded cars.

They weigh about ten tons each, and are mounted on four drive wheels. The drivers are provided with soft steel tires shrunk on and riveted. The locomotive has a single motor whose armature is geared to the four drive wheels. The tractive effect is greatly increased by this arrangement that compels all the drivers to work in unison. The wheels can adapt themselves to the inequalities of the track since the connection is sufficiently flexible without throwing the gears out of alignment. The entire mechanism of the locomotive is enclosed within the strong frame which protects it from any injury. The locomotive is provided with a most efficient headlight, which permits the locomotive to make better time. This lamp is composed of a parabolic reflector placed behind the carbons of a specially constructed arc lamp.

Two locomotives are used in this mine which has an output of 2,400 tons per day. The coal is handled by the locomotives from the various parts of the mine to the foot of the slope and from that point the cars are drawn up by cable to the tipple. The power house is located a short distance from the mouth of the mines and furnishes power not only to the locomotives, but also for numerous electrical appliances used in mining the coal.

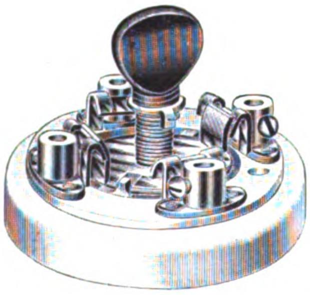
The power house contains four boilers, 72 inches by 18 feet, of the tubular type. Water is obtained from artesian wells. There are in the engine and dynamo room three Corliss, of 250 horse-power at 150 revolutions per minute. The generators are belted to the engine and are of 150 kilowatts capacity. A very neatly designed switchboard, placed in a convenient position, contains all the necessary instruments for regulating the generators. The face of the board is of white Italian marble and the instruments are of the Western make.


THE INDEPENDENT MINE LOCOMOTIVE.

This entire plant was furnished by the Link-Belt Machinery Company of Chicago, and it is said that when completed it will be the largest plant of the kind in operation. The installation was made under the supervision of Mr. D. N. Osyor, mining engineer for the above company.

Xntric Single-Pole Switch.

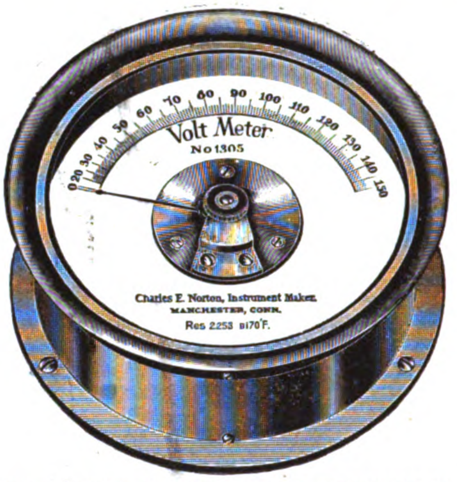
The H. T. Paiste Co., Philadelphia, have just issued a handsome illustrated catalogue of the 106 specialties they manufacture. We illustrate below a cut of the new Xntric switch, which has just been remodeled and greatly improved. The center spindle below the brass contact plate has on it an eccentric, around which is the steel eccentric strap. By turning the handle this eccentric moves the eccentric strap inward (at the same time winding up the spring) until its point is free from stop on base, when the spring instantly throws the contact arm a quarter turn, either breaking or making circuit, as desired.



The central spring has two functions to perform—to operate the switch and to always firmly hold contact plate to the contact posts. The contact has been lately improved, being made somewhat on the principle of a valve seat; this always insures a clean and substantial contact.

The Norton Station Instruments.

In the accompanying illustrations are shown the type of station instruments manufactured by Mr. Charles E. Norton of Manchester, Conn. These instruments have been constantly improved in various details, thus securing more accurate and reliable instruments. Durability has been sought for and the wearing parts have been constructed in such a manner as to make the reading reliable and recalibration unnecessary. When once calibrated the instrument does not change as in the permanent magnet type of instruments, where the magnets are apt to weaken with age.


0 20 30 40 50 60 70 80 90 100 110 120 130 140 150
Volt Meter
No 1305
Charles E. Norton, Instrument Maker.
MANCHESTER, CONN.
Res 2253 @70°F.
FIG. 1.—THE NORTON STATION INSTRUMENTS.

The finish of the instruments is neat and the cases are constructed in a substantial manner. The moving system is light and is pivoted in ruby jewels, with strong well-tempered and polished pivots. The instruments are intended to remain in circuit constantly. The scale divisions are longest where they will be most used in order to give the greatest possible deflection for a given variation. This allows also a finer and more accurate reading to be made. These instruments are made either for connections on the front or back of board. The accompanying cuts show the general design of instruments. The ammeters are made in sizes up to 1,000 amperes and the voltmeters up to 750 volts, each voltmeter reading from zero to its full capacity.

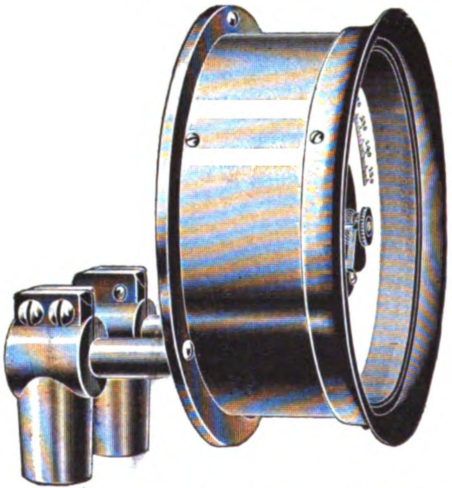


FIG. 2.—THE NORTON STATION INSTRUMENTS.

Sacramento's Carnival.

An invitation has been received to be present at the electric carnival to be held in Sacramento on September 9. It is to be a most novel and interesting demonstration, and is the more important because it celebrates the transmission of electric power from Folsom to Sacramento. This will admit of the city being transformed into a blaze of light on the night of the carnival, and arrangements have been made for electric arches, electric floats and brilliant illuminations that will be very beautiful. In the parade at night will be floats, bearing designs in lights of every color. It is to be a grand affair, and will, we believe, mark a new era in the history of the capital city.

ELECTRICAL CATECHISM

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[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. If there are questions you want answered, address the editor.]

[COMMENCED IN NO. 2, VOL. VI.]

93. *How can gas be lighted by a condenser?*

This is practically the same as was described earlier in connection with frictional machines. Connect one terminal of the condenser with the gas pipe by means of a wire, chain or wet string, turn on the gas and bring the other terminal of the condenser near the gas jet so that the spark will pass through the stream of gas. If you do not mind a shock, hold one terminal of the condenser in one hand, turn on the gas and bring the other condenser terminal near the gas jet while still holding the gas cock. The discharge will then pass through your arms.

94. *Can static electricity be measured?*

It is difficult to measure its *quantity*. The pressure or *potential* can be accurately measured by various forms of electrometers. Electrometers are based upon the simple principle that there is an attraction between bodies at different potentials, or, as sometimes stated (see A 25 in March ELECTRICAL INDUSTRIES), that bodies similarly charged repel each other, while bodies oppositely charged attract. The commercial forms are known as "electrostatic voltmeters.

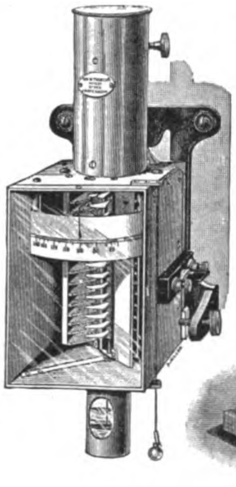

FIG. 21.

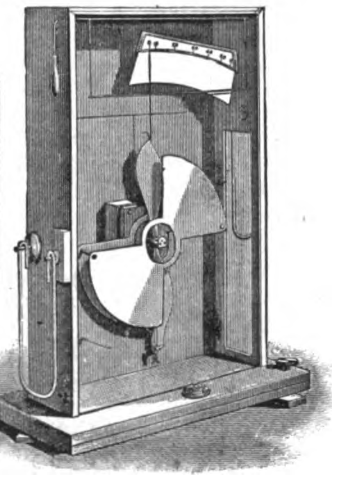

FIG. 20.

95. *Describe the electrostatic voltmeter.*

The simple form is illustrated in Fig. 20. It consists of two butterfly-shaped sheets of brass parallel to each other and metallically connected together and to one binding post, but carefully insulated from the rest of the instrument. Midway between them is the "needle," a light and thin strip of aluminum pivoted on knife edges and carrying a light pointer at the upper end. The lower half is slightly heavier than the upper half, so that the needle stands at zero. The needle is carefully insulated from the stationary plates and is connected with the other binding post. When the two binding posts are connected with the terminals of a dynamo or any other points having a considerable difference of potential, the plates and the needle are charged to the same differences of potential and attract one another. The needle, therefore, moves so as to get closer to the plates, or, what is the same thing, swings on the knife edges so that a larger part of the needles is between the stationary plates. Since the lower half of the needle is heavier than the upper, any motion of the needle means lifting a weight, so that the electrostatic attraction is balanced by gravity. The amount of the motion of the needle, therefore, measures the difference of potential between the needle and the fixed plates or between the points connected with the binding post of the voltmeter. Since the attraction is mutual, it makes no difference which terminal is positive and which is negative. For this reason the electrostatic voltmeter is well adapted for measuring voltage with alternating currents. Another advantage is that the electrostatic voltmeter requires no current and so does not heat or waste energy. The form of voltmeter shown in Fig. 20 is suitable for differences of potential between 200 and 20,000 volts. Another style is made for potentials up to 100,000 volts.

96. *Can electrostatic voltmeters be made to measure less than 200 volts?*

The multicellular form is used for pressures between 40 and 1,600 volts. The Thomson or Kelvin styles of multicellular voltmeter as shown in Fig. 21, contains a large number of stationary plates. Several needles are placed one above another and fastened to the same vertical wire. The system of needles is supported by a fine wire, which becomes twisted when the needle moves. In this instrument the torsion of the suspension wire is its controlling force.

97. *Is not the electrometer sometimes made for measuring small differences of potential?*

The "quadrant electrometer" designed by Lord Kelvin is sometimes made very sensitive so as to measure as low as $\frac{1}{1000}$ volt, but it is a very delicate laboratory instrument. It is valuable for measuring differences of potential where no current is flowing or where current is undesirable.

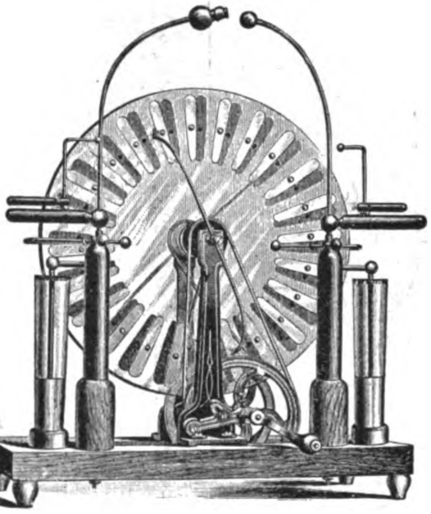

FIG. 22.

98. *Can an electrometer be used to measure different kinds of electricity?*

The electrometer will measure differences of potential, no matter from what source. It shows that the electricity obtained from chemical batteries or from dynamos. The electricity from friction is small in quantity but high in electromotive force or pressure, while that from batteries is comparatively small in pressure but may be of considerable quantity. By connecting several thousand cells of battery in series, one may obtain precisely the same effects as from belts or friction. Also by proper arrangements one can obtain from a source of static electricity, such as a belt, the same effects as are produced by current from a battery.

99. *Can static electricity be produced in greater quantity than by a belt or a frictional machine such as is described in A 35?*

More modern machines, such as the Toepler-Holtz or the Wimshurst, are commonly used for obtaining large quantities of static electricity. A Wimshurst machine is illustrated in Fig. 22. These do not depend upon friction, but upon electrostatic induction or "influence." The theory of them is somewhat complicated and to understand them one should consult Thompson's Elementary Lessons in Electricity and Magnetism, or some modern textbook of physics. They are based upon the principle that the difference of potential between two oppositely charged bodies is greatly increased when the distance between them is increased. This is probably one source of the electricity of the clouds.

100. *Is the air itself electrified ?*

It seems so. Probably the electricity in clear air is carried by the invisible particles of moisture always present. The atmospheric electricity undoubtedly has much to do with the growth of plants and animals. The sharp spines on the edges of leaves and the fine hair on most plants seem to be partly for the purpose of collecting electricity from the air. It is found that under shade trees the air is less electrified than away from them, and many eminent scientists believe that is why grass does not grow so well under trees as in open fields. They think the shade is not the only reason, and perhaps not the principal one. Probably the reason why nothing grows well under pine or cedar trees is that the many sharp points of the pine needles deprive the surrounding air of its electricity. It is found that the evaporation of water from animals and plants is much faster in electrified air.

101. *What causes the lightning ?*

The clouds are more or less charged with electricity. When the differences of potential between two clouds or between a cloud and the earth becomes very great, the air cannot stand the strain and "breaks down," allowing a discharge to occur between the two. Much study has been given to this subject and much remains to be learned. Several theories have been proposed to explain the electrification of the air. When water evaporates, the particles of moisture are found to be electrified. When these particles collect and form clouds their charges unite, each drop of water containing the charges of the particles composing it. As the drops get larger and larger, their potential also rises and the whole cloud is electrified more and more strongly. It is often noticed during a thunder shower that the raindrops are larger just after a lightning flash overhead. The peculiar yellowish color in the clouds during a thunder storm is probably caused by small discharges between drops or between small clouds in the larger cloud mass.

102. *What causes the "heat lightning" often seen summer evenings when there is no thunder storm near ?*

This is the reflection from lightning in distant storms. In one investigation it was found the "heat lightning" was reflected from a storm over one hundred miles away.

103. *Has atmospheric electricity ever been used, or is it likely to be ?*

The quiet effects of the electricity are doubtless of great value in agriculture. The lightning apparently causes the formation of more or less nitric acid and ammonia found in the air after thunder showers. Many interesting experiments have been made. Probably the largest commercial enterprise developed from atmospheric electricity is the manufacture of lightning rods and lightning arresters.

104. *Are lightning rods of any value except to the agent ?*

When properly put up they are undoubtedly a source of much protection. The conductor should be made of galvanized iron rather than of copper: flat strip is some better than round or fancy star-shape. Sharp bends and corners in the conductor should be avoided. The conductor should be carried to all high points of a building, should be insulated from the building, and should be well connected with good, deep, *wet* earth independent of gas or water pipes. All metal work on the outside of the building, such as water pipes, iron cresting, etc., should be connected together and to the earth, but *not* to the lightning conductor. "The cheapest way of protecting an ordinary house is to run common galvanized iron telegraph wire up all the corners, along all the ridges and eaves and over all the chimneys; taking them down to the earth in several places to damp ground, and at each place burying a load of broken coke or charcoal to hold moisture." Lightning rods should not be left on buildings after the connection with the earth is broken or removed. It is found that the network of wires used in cities for telephone, telegraph and other purposes is a great protection. Cases of buildings and trees being struck by lightning are much less frequent in such cities than in the country.

105. *What is the principle of the lightning arresters used for protecting electrical apparatus?*

Many of these depend upon the fact that lightning discharges will jump across air spaces that are good insulators for the regular working current, while they find difficulty in passing through circuits containing electromagnets. The complete theory is complicated and cannot be understood without a broad knowledge of electricity. The aim of the arresters is to provide a path for lightning to get to the earth without going through the instruments or other apparatus. Arresters for electric light or power circuit also requires some arrangement to prevent the regular working current from following the lightning.

106. *Does lighting often strike electric light or telephone lines?*

Lines are very rarely struck with actual lightning from the clouds in the way that trees are struck. The lines become charged to a high potential by induction from lightning flashes or from the passing of clouds that are highly charged. The induction from the presence of clouds is similar to that described in A 70 (Electrical Industries, June, 1895).

The Testing of Lubricants.

With reference to the influence exerted by the viscosity of an oil upon the co-efficient of friction, this is a matter which can only be determined by actual experiment with some form or testing machine, and it will be convenient at this point to give some account of those which are accessible. Before doing so it is well to impress upon the users of oils that this is by no means idle trouble, or that the expense of a trial is thrown away. The experience of every user of oils, who has taken the trouble to ascertain the facts must have shown that the loss sustained by the employment of an unsuitable lubricant can be counted by more pounds than there are shillings in the value of the oil. It is not a question of saving oil, but a question of avoiding unnecessary friction. If users will bear in mind the almost innumerable frictional surfaces existing in the average textile factories, and remember the high velocities at which the shafts and spindles are run, they will see that a minute diminution in the lubricating value of an oil will have an enormous effect in the aggregate. It is worth emphasising that the two things which have the greatest influence upon the co-efficient of friction of moving surfaces are the velocity and pressure. The maximum of the latter is usually found in connection with slow moving parts, and its effects can be easily guarded against, the result of a high velocity is not so easily ascertainable, and it is therefore of great importance. For these reasons the adoption of a testing device may be recommended, not as a plaything, but as a really useful and effective instrument in the economy of the mill. Large users of lubricants, such as railway companies, habitually employ them, and in a less degree they will prove valuable to a millowner. The comparative viscosity of oils can be ascertained by using a small glass funnel formed at its lower end with a small hole, placing in it a specified quantity of the oil to be tested, and noting the number of drops passing per minute. If a standard oil has been previously tested, the comparative value is thus obtained, but no accurate data will be got in this way. The use of a testing machine is, therefore, to be commended in any case.—The Practical Engineer.

Electric Railway Washington to Baltimore.

The subject of an electric railway from Washington to Baltimore has again been revived, and it is reported that a contract has been let for the construction of such a road. This road is called the Columbia & Maryland Electric Railway. The specifications call for a double track road, constructed with heavy rails and rock ballast. The road is to be constructed in the substantial manner followed by steam roads, and is intended for an express as well as local business.

The National Association of Manufacturers meets in Chicago on October 15th next. Manufacturers from all parts of the continent are expected to be present.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—ED.]

CUT-OUT IN THE PRIMARY CIRCUIT OF TRANSFORMERS.

At the recent convention of the Northwest Electric Light Association the question was asked, "Can the primary coils of a converter be cut out automatically when there is no light burning on the secondary?" This question was answered in the negative by several well-informed electrical men. However, one of the gentlemen present said that an electrician in Chicago had invented a device that would accomplish this desired end. Since the convention this same query has been asked by other managers of central stations, who are looking for economy in operation, and to their questions I feel compelled to answer it is, if not impossible, impracticable. Yet, if there is anyone who can do it I would be pleased to turn over to him the names of a number of central station men anxious to investigate and adopt anything that will promise a saving, as a device of this kind certainly would.

CHICAGO. THOS. G. GRIER.

THE PRICE OF INCANDESCENT LAMPS.

I notice some one is puzzled over the great difference in the prices asked for incandescent lamps, but the cause of this he does not appear to see. While the sharp competition in this line of goods would seem to have a great influence on the price, it can not all be attributed to that cause. It is not the old companies nor the new ones entirely that are cutting prices. The bids that were recently submitted to the government for a lot of incandescent lamps showed a difference in one or two instances of more than one-half. Thus the higher bids were more than twice the amount of the lowest. The specifications called for a candle power of 3.8 watts when new, but the life of the lamp was not specified. These lamps would probably, to pass inspection, have to be of this specified grade. It cannot be said, therefore, that lamps sold at a lower price are inferior, as experience has shown the contrary. I believe in buying in the open market, and only of those who are willing to guarantee their goods. H. H.

Greenville.

For one wishing to learn the methods of wiring fireproof buildings a visit to such a building during the process of construction would prove the most satisfactooy. When G. L. is next in Chicago or some other city in which fireproof buildings are being constructed if he avails himself of the opportunity he can examine the methods employed for wiring such buildings. These methods are being constantly changed; the present practice is not the practice of a few (two or three) years ago, and probably will not be the practice of a few years later. There are many such buildings, which were wired some years ago, with the wiring done much in the same manner that frame buildings were wired. The wires are held in place with cleats nailed to the tile and concealed by the plaster. Another method of fastening the wire was by means of small pieces of cloth, the ends of which were forced into a small hole cut in the tile, and held by a small wooden wedge. This method was not, however, very extensively used. Wiring imbedded in the plaster has not been the most satisfactory, and many such installations have been taken out and the more modern method of interior conduit has been put in. This method is best explained in the catalogue which may be obtained either of the manufacturers, the Interior Conduit & Insulation Co. of New York, or their western representatives, the Central Electric Co., Chicago. In the construction of fireproof buildings the most permanent construction is aimed at, and the electrical installation is made to conform with the rest of the building and its equipment.

CHICAGO. T. B.

FIXTURE HANGING.

The inquiries made by D. C. S. in the last number of ELECTRICAL INDUSTRIES suggest the difficulties nearly always met where provision is not made for hanging the fixtures when the building is wired. I know that specifications are often so loosely drawn that when the wiring is done by one party and the fixtures furnished by another the duties of each are not clearly defined and serious trouble in this way results. In wiring old buildings a certain amount of trouble is experienced where an effort is made to preserve the plaster and finish of the interior, but in a new building, if provision is made when the wiring is done, no difficulty will be experienced. When gas is not provided for, "blind outlets" are found the most satisfactory for both electroliers and brackets, as they afford a firm support that does not allow the fixture to swing. I believe that where lights of two or more rooms are on one circuit there should be placed a cut-out on each electrolier. By this method, if a short circuit occurs on one electrolier, all the lights do not go out and the trouble is more quickly located. Rubber insulation, I believe, is the better protection for fixture wiring, as it is the better protection from dampness, which is most apt to collect around the fixture. An insulating joint, I believe, is necessary for every combination fixture, and is a greater safeguard than a fuse block.

QUINCY. L. W.

Electric Power For San Francisco.

Seventy-five miles north of San Francisco there is situated, at an elevation of 1,317 feet above the sea, a body of water known as Clear Lake. It has its outlet in Cache Creek, a stream supplying about 327,000,000 gallons of water daily. The plan of a newly formed company is to construct a big dam on the creek some five miles below the lake outlet. From this reservoir the water will be carried in large pipes along the stream to a point known as Wilson's farm, where a power plant will be established. In traversing this distance the water will have a fall of 454 feet. It is estimated that three lines of pipe will develop 28,950 horse-power at the dynamos, 72 per cent of which, by electrical transmission, will deliver 20,845 horse-power to the motors in San Francisco. The water will be shot through Pelton wheels which will be connected directly with the dynamos. The latter will be among the largest and most powerful in the United States. The electricity will be transmitted in a direct overhead line on large bare copper wires to San Francisco and the adjacent cities. The transmission of the electricity under the waters of the bay is a most difficult and costly problem, but it is thought that recent inventions have made this possible without too much loss of power.—American Machinist.

A Few Bad Breaks.

BY EDDY CURRENT.

What relation is Alex. Tricity to Jennie Rater?

If "Electricity is life" can you dynamo than once?

If a lineman were to be Knighted should his title be Sir Kit?

If Noah made the Arc light on Mount Ararat, where did the incandescent light?

If curents are the fruit of the electric plant, are they raised from a "ground"?

If necessity is the mother of invention, is it the grandmother of a patent right?

If you can't telephone when you see one, can you be expected to telephony story?

If line wire the salesman's practice in early days, how much motor make a sale is required now?

If 1,000 watts will kill a man, what does it take to kilo watt?

Don't expect metre tell you.

PERSONAL.

Mr. G. E. Emmons is now manager of the General Electric Co.'s Schenectady works.

Mr. Frank S. Marr, of the Helios Company, Philadelphia, made a visit to Chicago last month.

Mr. Joel Hurt has resigned the presidency of the Atlanta Consolidated Street Railway Co., of Atlanta, Ga.

Mr. H. J. Gille has been appointed northwestern agent for the Washburn & Moen Mfg. Co., with headquarters at St. Paul.

Mr. Fred Fischer, of the Fischer Foundry and Machine Co., Pittsburg, Pa., was in Chicago on business for a few days last month.

Mr. Fred B. Hubbell has been elected president of the Home Telephone Co., of Baltimore, which is about to construct a telephone system.

Mr. George K. Hooper has resigned his position with the Abendroth & Root Mfg. Co., to accept a position with the Deering Harvester Co.

Mr. Max A. Berg, formerly with the Wallace Electric Co., has accepted the position of western manager for the Ohio Brass Co., of Mansfield, O.

Mr. J. A. Innes, secretary and purchasing agent of the Eagle Grove Electric Co., of Eagle Grove, Iowa, called at the offices of ELECTRICAL INDUSTRIES last week.

Mr. C. W. Woodward has recently been appointed western manager for the Electric Storage Battery Co., of Philadelphia and has opened offices in the Monadnock block, Chicago.

Mr. Geo. P. Brophy, vice-president of the Ottawa Electric Railway Co., recently suffered a sad bereavement in the death of his two sons, Walter and Edward, aged respectively 20 and 13 years, who were drowned while on a canoeing expedition.

Mr. E. F. C. Davis, president of the Am. Society of Mechanical Engineers, was accidentally killed while riding in Central Park, New York, on Aug. 6. Mr. Davis was born 48 years ago, at Richmond, Va., and since leaving college has been connected with several large iron works. He came to New York early in the present year to take charge of the works of the C. W. Hunt Co. His many friends were pained to learn of his untimely death.

NEW BOOKS.

Report of the proceedings of the Eighteenth Convention of the National Electric Light Association, New York, 1895. Published by order of the Executive Committee.

Although the papers and discussions have previously been published in the technical papers, yet the complete proceedings compiled in this form are most conveniently arranged for reference The binding is uniform with previous volumes, and is neat and durable. An excellent portrait of Mr. M. J. Francisco, ex-president of the association, is placed opposite the title page. The matter has been carefully arranged and the printing well done.

Year Book of the Society of Engineers. University of Minnesota, Minneapolis, Minn., 1895; 145 pages; paper; price $0.50.

This volume contains a number of interesting articles on a variety of engineering subjects, by members of the society, and lecturers before the society by eminent engineers. Among the articles on electrical subjects are "Some Alternating Current Notes," by Harry L. Tanner and "The Competitors of Electric Light" by Prof. Geo. D. Shepardson. The latter, however, can hardly be classed as electrical but will be found of interest to electrical men since it gives a history of artificial lighting and describes the present competitors of the electric light. The papers describes especially the gas light as ordinarily used and the more recently perfected Welsbach burner. In conclusion the author says: "In comparing the desirability of various illuminants, we might well consider four principal items, namely, quality, efficiency, by-products and cost. Under quality should be considered steadiness, color and intensity. For reading or other special lighting, one of the most objectionable features of gas light is the continued flickering that seems unavoidable with flat flames. For this reason, as well as on account of greater cheapness, kerosene lamps will doubtless continue to be used for the bulk of domestic lighting. The color of the light is of importance for many purposes. The human eye is constructed for day light, and the more nearly the character of artificial light approaches daylight, the better for vision and for the health of the eye. The white character of the electric arc, the calcium and the magnesium light, render them preferred where careful distinctions of colors are desired. The gastly, greenish tinge of the Welsbach light is its greatest drawback. The constant aim is to rival the intensity of daylight."

The Stationary Engineers' Gazetteer of Illinois, Chicago, 1895. Stationary Engineers' Gazetteer Association, 140 pages; price —

The first edition of this gazetteer is just from press and is most attractive in every feature. The directory of the National Association of Stationary Engineers is most convenient for reference. The directory of chief engineers, engineers in charge for the state of Illinois gives also the character of plant and size. The names appear in alphabetical order. This directory is followed by a directory of power plants, also arranged in alphabetical order. The directory of engineers' supply houses will be found of advantage to engineers. The volume is neatly and durably bound, the advertising pages are well filled and tastily arranged. A colored rule gives an attractive finished to each page. The volume gives evidence of most careful work in compiling and will be found a valuble directory of the stationary engineers of the state.

The Brush Arc Light System. By H. C. Reagan, Jr., New York, 1895. Norman W. Henley & Co. Illustrated: 8 vo; cloth; price, $1.00.

In compiling this volume it has been the aim of the author to give a clear and simple explanation and illustration of the parts of the Brush arc dynamo. It is designed for the student, the engineer and the attendant in charge of such machines. The aim of the author has been attained in an excellent manner. The cuts and illustrations are particularly clear and if studied in connection with the text the reader cannot fail to gain an excellent knowledge of this type of dynamo. Each part is taken up separately and its construction and operation is fully described. A chart accompanies each volume, so arranged as to show the circuits of the dynamo, the commutation of the current with the revolution of the armature. The volume is substantially bound in cloth and contains besides the pages devoted to the description of the Brush arc lighting system a number of blank pages for memoranda.

Electric Motive Power: The transmission and distribution of electric power by continuous and alternate currents. With a section on the applications of electricity to mining work. By Albion T. Snell, London, 1894. The "Electrician" Printing & Publishing Co. Ltd. Cloth; 400 pages, price $4.20.

As the literature on this subject is exceedingly limited, this work has been most favorably received. Its size, however, does not permit the attention to details or the treatment of the many divisions of the subject at sufficient length or to touch upon every side of the subject as to make it complete. The rapid advancement in the use of electric power, to which branch of the electrical industry great attention is now being given, renders any work incomplete in a few years. Much of the work of engineers is of an experimental character and sufficient time has not elapsed to prove the practical nature of many installations. It is therefore most difficult to present the subject of electric motive power, its transmission and distribution in a manner that will give to the reader a complete knowledge of present practice. This work deals with that which has proven its right to a place in the literature of the subject. The design of motors and dynamos is treated in the first part of the volume. Overhead and underground conductors are next briefly touched upon. The bulk of the volume is devoted to descriptions and discussions of the three systems—direct current, single and polyphase currents—for the distribution and transmission of electric power. The subject is treated from a European standpoint, the author following the English practice, which cannot be said to possess the variety, nor is their present the numerous examples that are to be found in America. The operation of these systems is explained, but as to the management of stations and the care of the apparatus nothing is said. The final eighty pages are devoted to electricity as applied to mining, describing the many electrical machines used in the mining of coal and the metals. The volume will be found of interest and assistance to all engaged in the industry or desiring a knowledge of the subject of the transmission and distribution of electric power.

Machinery Wipers of Raw Silk.

Raw silk machinery wipers, while not new, have recently grown in favor until they are supplanting in many plants the old form of wipers. Some fifteen years ago they were introduced in Vienna, Austria, by Mr. Haac and soon found a ready market. That was the beginning of their use, which soon became general in Europe. No objection was made to the washing of the silk in Europe but the free and liberal minded superintendents in America were inclined to respect the wishes of their men who were prejudiced against washing the greasy wipers. To overcome this objection it was found necessary to device a special compound for use with the wipers, which is not injurious to the wiper and is economical and efficient in weak solutions, so that the work of cleaning is shortened and rendered easier, while the wiper does not accumulate so much grease and dirt, most of it being left in the solution for cleaning. Thus while the introduction of the wipers in this country was slower than in Europe, after once being tried their adoption has been rapid, especially in railways and electrical plants, where matters of economy and safety are readily adopted. These silk wipers can be washed and used again and again. They are devoid of the liability to spontaneous combustion, a danger which is always present with cotton wipers. A number of years ago Mr. Felix Haac commenced the manufacture of raw silk machinery wipers in St. Louis, Mo., and the business has gradually grown until now it is handled by the American Silk Mfg. Co. of 309 Walnut St., Philadelphia, founded by Mr. Haac in 1887. The company recently acquired the Royal Silk Mfg. Co. of New York and is looking toward a still greater extension of the business.

TRADE PUBLICATIONS.

Murphy's packless valve is listed in a circular sent out by the makers, the Van Auken Steam Specialty Co., C. P. Monash, Mgr., Chicago. The particular points distinguishing this valve, are pointed out. Its construction is shown by detail cuts. As the name indicates no packing is required. The disc in the neck of the valve does the work. The valve is guaranteed steam, gas, air and water tight. It is designed for either high or low pressure.

"Proofs," is the title of a pamphlet issued by the Hogan Boiler Co., of Middletown, Conn. It is of the same size and style as "Truths" noticed in the last issue of this journal. The proofs presented are such as a purchaser should have when buying boilers. The first table presented, which is neatly arranged, gives the extra first cost of materials and appliances and average extra floor space required where other than this make of boilers are used. Proofs and facts relating to the evaporative capacity of various coals when used in the Hogan water tube boilers are next given. The pamphlet concludes with various facts regarding the design, construction and operation of the Hogan water tube boilers.

A small circular recently received describes the individual signals for telephone lines as used in the telephone exchange systems of the Dudley Electric Mfg., Co., of New York. The system has been devised for a most economical use of wire and apparatus in a telelphone exchange. A ten drop switch board is shown, which on this system is large enough for one hundred subscribers. The system is illustrated diagramatically. The Dudley transmitter calls automatically the subscriber wanted without ringing other bells on the circuit, the system permitting ten subscribers to be connected without interference on one circuit. This system is said to save two-thirds the cost of the ordinary single wire service.

A small pamphlet entitled "An Ideal Engine Room," has been issued by the Harrisburg Foundry and Machine Works of Harrisburg, Pa. It contains a number of very complimentary press notices of the engine room of Keith's new theater, Boston, in which the Harrisburg Ideal engines were installed, operating the dynamos which furnish lights for the theater. The pamphlet is gotten up in a very attractive style. The taste which it shows in the design and arrangement are of a high order and it will be a most effective advertisement of this well known make of engine. The pamphlet also contains a number of most excellent views of the Ideal engine separate and also directly connected to several of the standard types of dynamos.

New catalogue of the Clayton air compressors has recently been issued by the Clayton Air Compressor Works of New York. It is number eight of the series and presents the latest ideas in compressed air machinery. The contents open with an article on the "Widening Use of Compressed Air." which is extensively illustrated and shows the variety of purposes for which compressed air is used. The Clayton air compressors are next described and illustrated. The details are shown by individual cuts showing the particular part of the apparatus. Tables give sizes and the many facts demanded in a perfect understanding of the subject. Clayton boilers, pumps, drills, etc., are next described. A large number of testimonials from users of the different kinds of apparatus made at these works complete the contents.

The "Man of the Month" selected as the subject of the leading character sketch in the August Review of Reviews, is Theodore Roosevelt, the intrepid police commissioner of New York City. The writer of the sketch is Julian Ralph, who, as a journalist, has followed closely Mr. Roosevelt's remarkable career since the young Knickerbocker first began to stir up the dry bones in politics as an Assemblyman from New York city in the State Legislature. The article is in large part based upon an interview which Mr. Ralph had with Mr. Roosevelt, in which the new commissioner told what he considered to be his duty as president of the police board, and what he proposed to do. It is a lively article upon a lively subject, and emphasizes, what has long been recognized, that the Review of Reviews is quick to note for its readers the important forces which from day to day are making for the progress of the world.

The Petersen electric conduit system is described in a pamphlet recently issued by the Petersen Electrical Works of Milwaukee, Wis. Numerous drawings show the designs of the different parts of the conduit system which is fully described. The general advantages of the system are explained and also the flexibility of the system enabling it to be used on different systems both single and double tracked with the minimum expense, for construction. The main feature in the design of this conduit is the separate compartment for the trolley wire, which is closed, except as the trolley is passing. All foreign matter, water, dirt, etc., is excluded from the conduit. Snow cannot drift in and fill it and thus the various annoyances which seriously interfere with the successful operation of underground conduit systems are provided against. The slot opens into a chamber which is provided with suitable connections to the sewer and rubbish is removed by a broom attached to the car. The method of installation is described. A view of a street with this system of railway in operation is shown.

FINANCIAL.

The Gerson Electrical Mfg. Co., of Philadelphia, Pa., assigned last month to George W. Wilgus. The company manufacted the Gerson telephone and telephone accessories.

The assignment of the Cutter Electrical & Mfg. Co. of Philadelphia is announced. A statement has not yet been prepared but will be completed soon for the information of creditors.

The announcement was made last month that an agreement had been reached by the Westinghouse El. & Mfg. Co. and the proprietors of the Baldwin Locomotive Works, for the combined construction of electric locomotives. The Westinghouse company is to construct the motors and other parts of the electrical equipment, the trucks, etc., being constructed at the Baldwin Locomotive Works. It is said that the agreement is merely for mutual advantage in the production of this class of locomotives. The advantages of each for the construction of their particular parts are far superior than could probably be contained in a combined plant.

BUSINESS NOTES.

Mr. S. F. B. Morse, September first, succeeds to the business of S. F. B. Morse & Co., Marquette Bldg., Chicago. The General Western Agency of Kerite wires and cables will thus be exclusively in the hands of Mr. Morse.

The Thompson-Brown Electric Co., of Boston, gave their friends an outing last month. Guests to the number of about one hundred accepted the company's invitation and enjoyed the pleasant trip which had been arranged.

Chas. A. Schieren & Co., of New York, Boston, Philadelphia, and Chicago, amongst recent foreign sales report an order for three 26 inch double perforated electric belts, 105 feet long each, for an electrical plant at Rouen, France.

The Joseph Dixon Crucible Co., Jersey City, N. J., has placed before the trade a commutator lubricant in stick form, very convenient for use. It is made of a peculiarly rich and smooth graphite, and has been found most satisfactory in use.

Chas. A. Schieren & Co., New York, recently received the order from the Southern Electric Light & Power Co., for four great belts. These belts are 64 inches wide; three of them 162 feet long, and one 94 feet long, a total of 580 feet of 64 inch belting. This is a most important contract and the company should be congratulated on having obtained this order.

American Silk Mfg. Co., 409 Walnut St., Philadelphia, reports among recent orders for silk wipers the following, most of which are from companies who have been using silk wipers for some time: Watervliet Arsenal, West Troy, N. Y.; Powelton Electric Co., Philadelphia; Columbia Electric Co., Philadelphia; and the Edison Electric Illuminating Co. of New York.

The American Institute of Electrical Engineers have recently issued a little pamphlet which has been prepared especially to meet the demand for information regarding the work of the Institute. Copies are sent on application to the secretary of the institute at 26 Cortlandt St. The pamphlet besides other information contains a list of members of the institute, which now number 950.

The Rawhide Mfg. Co., Chicago, reports business improving and a specially good demand for rawhide pinions which is one of the company's leading specialties. The electric railways throughout the country are becoming convinced of the merit of rawhide pinions and consequently are increasing their orders for these goods very materially over those of last year. The outlook for the Rawhide company is certainly good.

The Fischer Foundry and Machine Co., Pittsburg, Pa., has secured W. H. Whiteside as its Chicago agent, with offices in the Medinah Temple. The company is fortunate in having secured the services of one so familiar with the electrical trade as it is the intention of the company to push the sales of its new engine for electric light and railway service, for which it is especially adapted. The company has recently brought out some new features in connection with this engine.

The Triumph Electric Co., Cincinnati, O., has opened an office with Turner Bros., 25 Marietta St., Atlanta, Ga., for the convenience of trade in that section. Mr. E. F. Seixas, formerly with J. Holt Gates of Chicago, is in charge of this department. Complete specifications for plants of all kinds will be made and plans drawn by this department. The installation of the exhibit of the company at the Cotton States and International Exposition will be made under Mr. Seixas' direction.

The Automatic Circuit Breaker Co. of Newaygo, Mich., have opened a Chicago office at 937 Monadnock Bld., with Mr. L. A. Farnsworth as manager, where they expect to carry a full line of their goods in order to be able to fill orders with dispatch. Mr. Farnsworth has just returned from a trip through Michigan and Wisconsin, and reports a number of good sales for their well-known circuit breakers; also some large orders since arriving in Chicago. A new catalogue entitled "Protection For Sale" is now in press.

The Vindex Electric Co., Chicago, is meeting with success in the introduction of its line of transformers, which are placed before the trade on their merits. So careful is the construction done, and so confident is the company in the success of their operation, that a guarantee for two years against disablement of any nature, lightning included, accompanies each transformer. Superior insulation and improved protecting devices place these transformers beyond the reach of the ordinary injurious elements that shorten the life of transformers.

The Commercial Electrical Supply Co., St. Louis, Mo., has passed from the management of Messrs. Einstien to that of Mr. Jos. Franklin and his son, Mr. Jos. Franklin, jr. The present officers of the company are: President, Mr. Joseph Franklin, jr., and secretary and treasurer, Mr. Joseph Franklin. The company looks forward to a most promising future, with an increase in the territory covered and in the customers in the states in which the company has enjoyed a fair share of business. Good material, prompt shipments and low prices are the lines along which the company can expect a generous patronage.

The Western Telephone Construction Co., Chicago, has made recent contracts as follow: The Ticonderoga Telephone Co., Ticonderoga, N. Y., equipment of a city telephone exchange and toll lines connecting Lake George and Lake Champlain; the Elgin City Railway Co., Elgin, Ill., for a private telephone line; Altoona Phoenix Telephone Co., for a complete exchange system at that point; Wapokonetka Telephone Co., for the apparatus for an exchange at Wapokonetka: The Lansing Telephone Exchange Co., Lansing, Mich., for an exchange system of 400 instruments and an exchange system for Barnesville, O.

The De La Vergne Refrigerating Machine Co., East 138th St., New York, American manufacturers of the Hornsby-Akroyd safety oii engine recently received a letter from Messrs. Richard Hornsby & Sons, the English makers of the above engines,containing the following: "We have just received from the English war office their third order for 25 B. H.-P., engines for search light signalling. This makes in all 17 engines of 25 B. H.-P., which the war office has ordered from us. You can understand that they are put to a very severe test and that it is most satisfactory to us to receive a third repeat order for them."

The Electric Appliance Co., 242 Madison St., Chicago, has taken the exclusive agency for the United States for the celebrated Gales commutator compound. The recent reduction in price will undoubtedly increase the sale. The company is sending out an advertising novelty in the shape of a printed wiring table made to fit the inside cover of your watch. It is known as Wells' watch case wiring table. Several thousand have already been sent out and any one who has not received one may get it on application to the company. Many orders and several very flattering compliments have been received for the Upton arc lamp. It is made in styles for any circuit.

J. M. Hill, Chicago manager of the Columbia Incandescent Lamp Co., of St. Louis, returned recently from a trip through Michigan. Competition Mr. Hill reports is very close in this section of the country among incandescent lamp makers but he says that the day of the poor lamp is a thing of the past and that there is a great inclination among lighting men to buy the best lamps that the market affords. The central station men he says have been brought to realize that in order to compete with the Welsbach burner the consumer must be supplied with a lamp that will not decline in candle power, as this decline has been the cause of the gas burner being put in. This is an encouraging sign and goes to prove that in order to hasten the downfall of the Welsbach burner the first class lamp must be used.

The Electric Storage Battery Co. of Phila., has just opened a branch office an 309 Dearborn St., Chicago. Mr. C. W. Woodward, who has for a number of years been prominently connected with the storage battery interests of the east is in charge of the office. This departure has been made necessary by the largely increasing volume of business in the west. The office is fairly equipped for demonstration and display, and in connection with it, will be established a charging station for the accommodation of patrons having portable batteries. A stock of cells of the smaller size will be kept constantly on hand. The firm of Pierce & Richardson will be connected with the office as consulting engineers.

The Metropolitan Electric Company, Chicago, has secured the western agency for the Ship Cored Carbons. These carbons are imported from Vienna, Austria. They have already established an enviable record, and as the Metropolitan company has placed a large stock order, they will be able to fill all orders for imported carbons promptly. The company has also been appointed selling agents for the Coe electric alarm mail box. This box is the latest improvement in the postal service. By a simple device the act of inserting the letter, rings the house bell a predetermined length and number of times, thus distinguishing the postman from a caller. It requires no extra wiring, battery or bell. It will not get out of order. Always operates. The Metropolitan company state that they are in position to fill orders for this box in three different styles and in any finish at a very reasonable price.

The Westinghouse Machine Company reports business active and the outlook very flattering. Orders for compound engines the past month, include one 250 horse-power to Whittenton Mfg. Co., Taunton, Mass.; one 100 horse-power and one 125 horse-power to American Hydraulic Dredging Co., East Dougles, Mass.; one 80 horse-power and one 100 horse-power to Sioux Consolidated Mining Co., Mammoth, Utah; one 200 horse-power to Wendell & Smith, Overbrook, Pa.; two 80 horse-power to Upper Peninsula Hospital for the Insane, Newberry, Mich.; four 250 horse-power to United States Capitol Building, Washington, D.C.; one 250 horse-power to Connellsville Electric Light Co., Connellsville, Pa.; one 250 horse-power to Belvidere (Ill.) Electric Company; three 160 horse-power to Carnegie Library Building, Pittsburg, Pa.; one 125 horse-power to Hackensack (N. J.) Gas & Electric Company; one 300 horse-power to Wilkinsburg (Pa.) Electric Company; one 250 horse-power to Sing Sing (N.Y.) Electric Company; one 200 horse-power to Gloversville (N. Y.) Electric Company. In addition to the above, the increased number of orders for "Standard" and "Junior" automatic engines, indicates a general revival in all branches of manufacturing.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED—Young man wishes situation in an electric light plant. Has had experience with dynamos and engines and is at present engineer of a large plant. Address Engineer, care Electrical Industries, Chicago.

WANTED: Position as manager or superintendent of central station. Experienced and in every way qualified. Address, 757 care Electrical Industries, Chicago.

WANTED—Position as superintendent of a central station by a mechanical and electrical engineer with eight years' experience, and a thorough commercial knowledge of the business. Address Competent, care Electrical Industries, Chicago.

WANTED—Position wanted as superintendent by a practical and experienced central station man, having been in charge and understanding the different departments and leading systems of lighting; also the economical management of steam plants. First-class recommendations from responsible lighting companies. Address Superintendent, care Electrical Industries, Chicago.

WANTED Position as Electrician and Superintendent of an electric light company, or Superintendent of some construction company. 12 years' experience in general electric construction and management of electric plants having had charge of some of the most important installations in the country. Can furnish the best of testimonials as to ability and attention to duty. Address 756, care Electrical Industries, Chicago.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

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ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. October, 1895. NEW YORK. No. 10.

The Two-Phase Alternating Current Power Distribution System at the Milwaukee Harvester Works.

Electricity grows rapidly in favor as a means of transmitting and distributing power. Such plants are becoming almost as numerous as lighting plants, which, in fact, now with few exceptions furnish power to a greater or less extent. The long distance power transmission systems, exciting the greater wonder, have attracted more attention from both engineers and the general public, yet distributing systems involving shorter distances are as remarkable and worthy of as great consideration.

In the former systems the alternating current has up to the present time been used exclusively, while for the latter the direct current systems have been the only ones practical. Recent discoveries, inventions and the general improvement in the alternating current apparatus have entirely overcome the disadvantages for power service and added some desirable qualities.

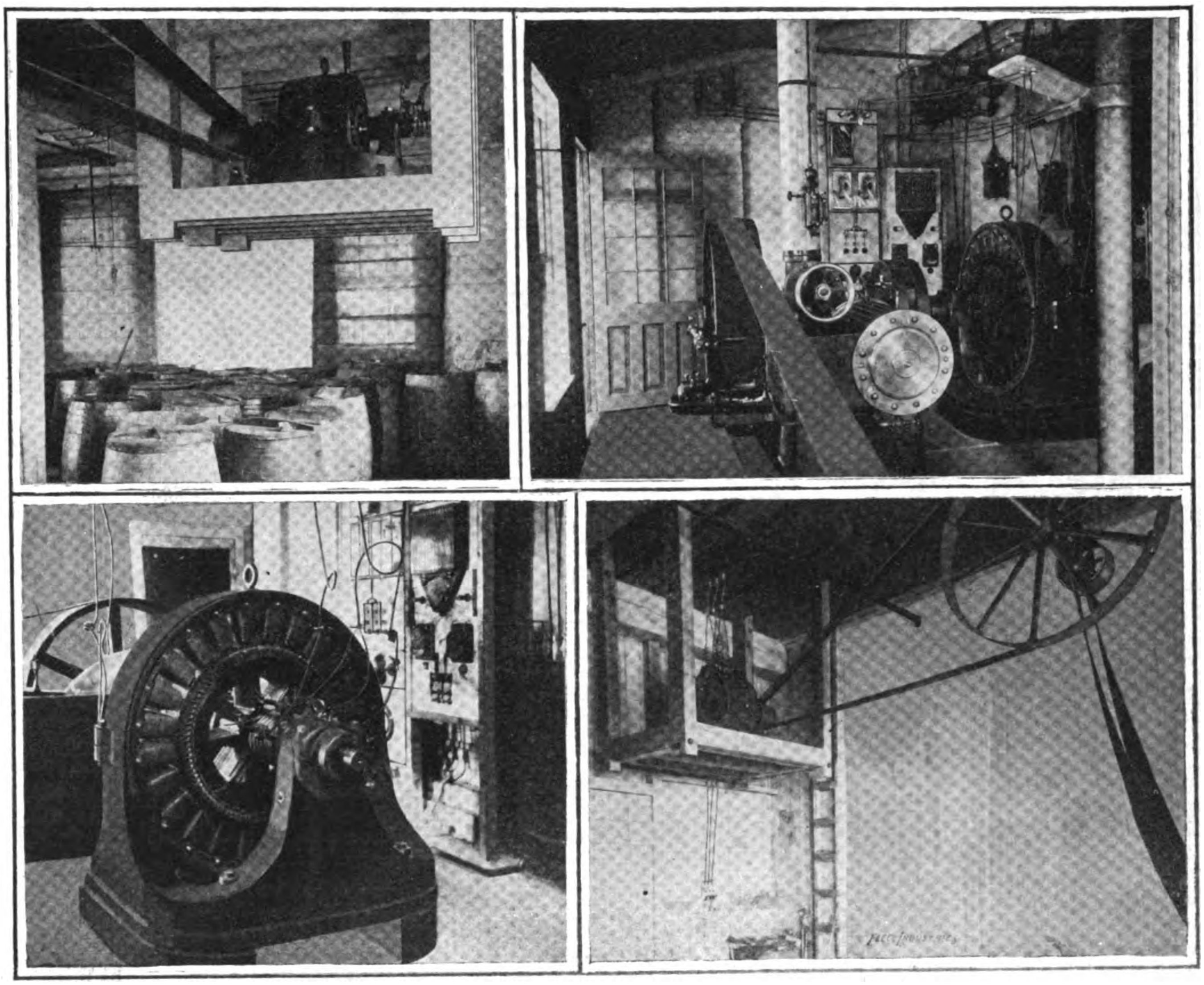

Fig. 1.—Motor in Paint and Oil House.
Fig. 3.—View of Generator.

Fig. 2.—Generating Plant.
Fig. 4.—Power Motor in Warehouse.

THE TWO-PHASE ALTERNATING CURRENT DISTRIBUTION SYSTEM AT THE MILWAUKEE HARVESTER WORKS.

The Milwaukee Harvester Company has recently installed at its extensive works in the southwestern part of the city of Milwaukee a two-phase alternating current system for the distribution of power from a central station through the works. This plant is the first of the kind installed in the Northwest and is therefore of more than usual interest. There are also a number of special features of the system that are worthy of mention. The plant as here described and illustrated is not as the plant will be ultimately but is a complete plant. The plan of the company is to erect a new power station near the center of the grounds and operate all the machinery in the works by electric motors. It was necessary to have power in some of the new buildings and at certain parts of the grounds not heretofore supplied, so the generator was installed in the old power house and the wiring was done so that it could easily be connected to circuits from the new station whenever it should be completed.

Power is now supplied to the paint and oil house, where a ten horse-power motor, as shown in Fig. 1, is belted to a shafting from which the paint grinders and mixers are belted. In the foundry a fifty horse-power motor drives the fans for the cupolas. A five horse-power motor in the harvester room is used to run the harvesters after they are set up while being tested. The elevators in the warehouses are operated by seven and a half horse-power motors and there is also a twenty horse-power motor in No. 3 warehouse. Two hundred incandescent lights are also wired from the same circuits and about 80 lights are wired from the exciter.

The motors are in every instance placed on platforms suspended from the ceiling as shown in Figs. 1 and 4. This arrangement places the motors out of reach of the workmen, so that there is no danger of interference and they take up no valuable floor space. The platforms are substantially built and the motors have a dry and well insulated base. Where a counter shaft is used the length of belt is in most cases shortened and it is up out of the way. The works cover a plat of ground containing something less than ten acres. The location of the motors, circuits and present power-house are shown on the plan, Fig. 5.

The electric power generating plant consists of a 100-kilowatt two-phase alternator directly connected to a 125-horse-power Ball & Wood engine, a Western Electric Co.'s direct current generator supplying current for exciting alternator and for incandescent lamps, and marble switchboard containing the regulating and testing instruments and devices.

The generator is one of the standard two-phase machines, built by the Westinghouse Electric & Mfg. Co., of Pittsburgh. It generates current at 440 volts, which is a sufficent pressure to reach all parts of the works without appreciable loss in transmission. The engravings, Figs. 2 and 3, show two views of the alternator.

The engine is a high speed, simple engine, built on a strong and secure plan at the works of the Ball & Wood Company, of New York. The engine and generator being directly connected, very little space is taken up by the power plant. The switchboard is placed immediately in front of the generator. It is built in the panel style, now almost universally followed by the larger companies. This method of construction allows additions to be made to the plant and panels added to the board in such a manner that at all times it will have a neat and finished appearance. The switchboard is fire-proof, the supporting frame being of iron and the marble face fastened by bolts. The instruments are mounted in glass cases, giving them a very neat effect.

The motors are of the Tesla two-phase type, which are now being extensively used. Their many advantages for power service caused them to be adopted at Niagara Falls and on many other larger power systems. The great weakness of alternating current motors until the recent inventions was the lack of sufficent torque at starting. One of the chief advantages of this type of motor, however, is its great starting torque, which equals three and one-half its running torque. As most of the motors in this plant are used continuously during working hours, the motors are left in circuit, and the whole plant is started with the generator. The generator comes gradually up to voltage, and the motors are thus brought gradually up to speed. The plant is shut down during the noon hour, and by this arrangement the whole plant is under the direct control of the engineer at the station. Should it be desired to stop any motor which is running or to start one, each motor circuit has a three-pole switch by which the circuit can be opened or closed. The motor circuits are also provided with fuse blocks.

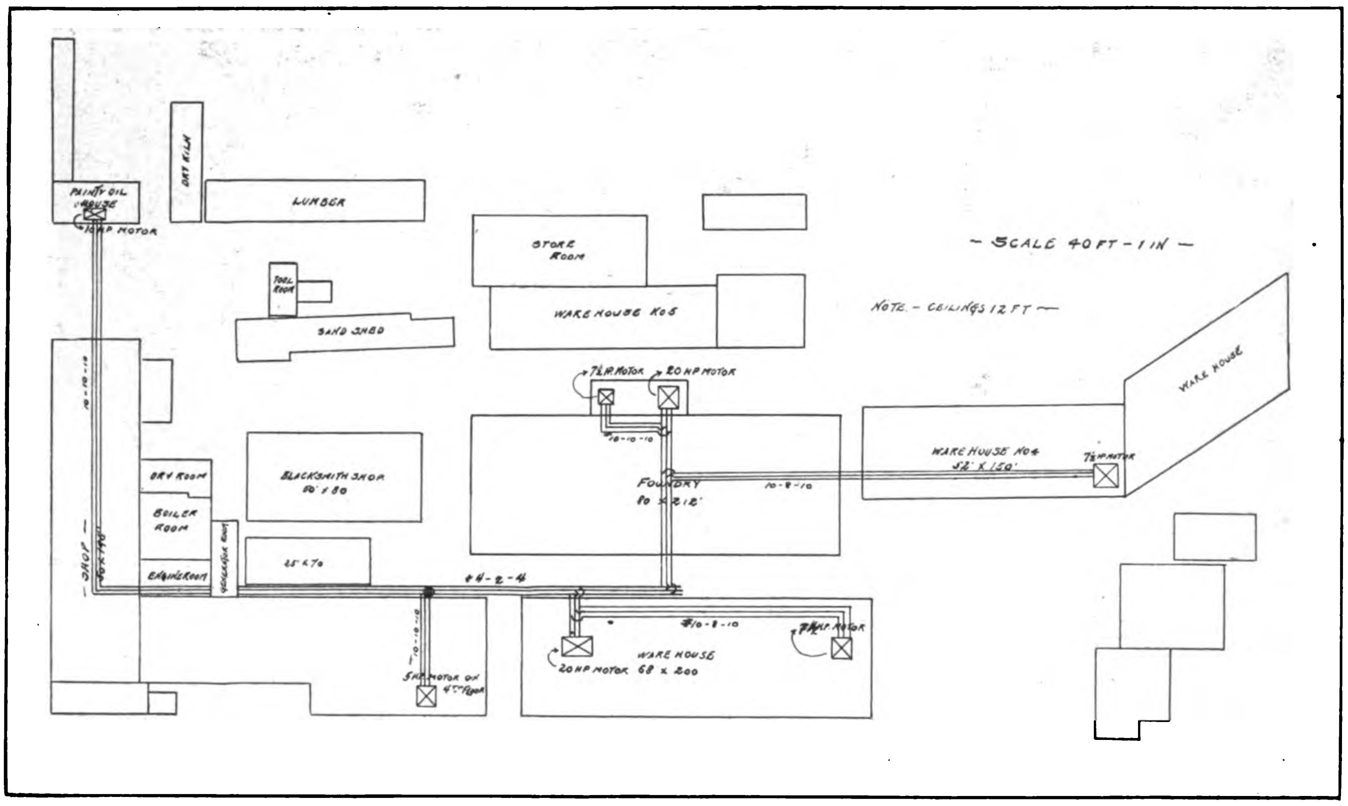

FIG. 5.—THE TWO-PHASE ALTERNATING CURRENT POWER DISTRIBUTION PLANT AT THE MILWAUKEE HARVESTER WORKS—PLAN.

The only transformers used are those for the lighting circuits. It will therefore be seen that in this alternating current power system there is no extra first cost for transformers, no transformer losses and every desirable feature possessed by the direct current systems. In the machines, however, there is a remarkable advantage. The motors have no complicated commutators and brushes, constantly requiring attention and wearing out. The first cost and cost of maintenance is therefore greatly reduced. The motors run noiselessly, and they have so far operated in an excellent manner.

This system of power distribution for manufacturing establishments enters in direct competition with the continuous current systems which have heretofore monopolized this field. Mechanical systems of transmitting power are no longer considered in the equipment of large works, so far superior are the electrical systems. In the selection of the electrical system one has, however, a number to choose from, and though alternating systems occupy a favorable position, each has advantages according to the conditions of service. The plans for this plant were drawn by Mr. Chas. G. Armstrong, and the installation was made under his supervision.

The Photometry of Arc and Incandescent Lamps.—II.

BY PROF. W. M. STINE.

THE DISTRIBUTION OF LIGHT.

This is a practical matter which will bear close study. The nominal rating of arc lamps in comparison with their actual lighting power has given rise to controversies almost without end, in great part due to a lack of knowledge of the distribution of the light about the arc. There are cases too, in which an arc lamp has failed to yield the expected illumination because it was not placed advantageously.

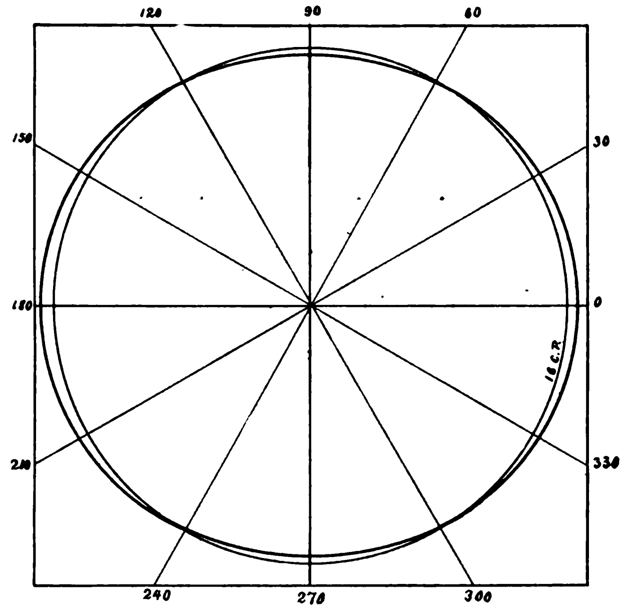

FIG. 1.

To take an ideal case, suppose the light to originate from a single brilliant point; the light will be given off equally in all directions, or all points on a spherical surface from the center of light will be equally illuminated. If this light point should be extended into a short line, the surfaces of equal illumination will no longer be spherical; and any change, in short, in the shape of the light center will produce a corresponding change in the surfaces of equal illumination. If to such changes in the shape of the light source be added the influence of small screens and reflectors, it is apparent that the distribution may be extremely irregular. The first assumed case, that of lengthening the light point applies to filament-incandescent lamps, the latter assumption to arc lamps.

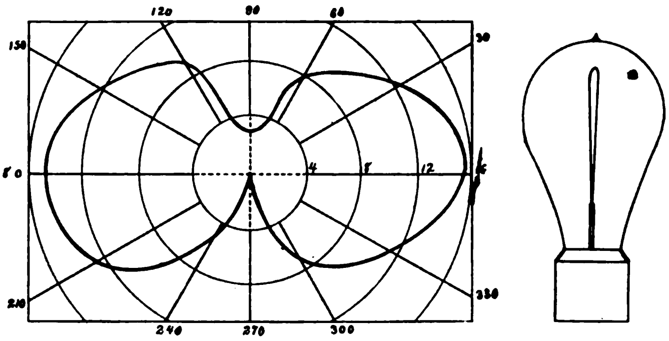

FIG. 2.

A mere line of light will again differ somewhat from a luminous surface in the extent and distribution of the light emitted. A very simple experiment will make the latter clear. Hold a pencil a few feet from a flat wick lamp flame, so that its shadow may fall horizontally on the wall of the room. Holding the pencil in this position rotate the lamp and note the changes in the shadows.

The shape of the filament of the incandescent lamp is usually such that the light emitted horizontally is nearly uniform. The candle power measured each 30° around such a lamp is shown in Fig. 1. The candle power curve is found to nearly coincide with the 16 candle power reference. The plane of this filament lay in the meridian passing through 90° and 270°. The various shapes of filaments, such as the slightly twisted U, the spiral loop, etc., each has its peculiar effect on the distribution, though this is only marked in extreme cases. The horizontal distribution from an incandescent filament is more nearly circular than that from any flat flame.

The circular distribution through the vertical plane is of more importance when the incandescent lamp is used to work by. Fig. 2 shows the candle power curve around the vertical plane taken at right angles to the plane of the filament. The reference lamp to the right will make this clear. In this case the filament was not flat, but slightly twisted as shown. Directly under the base of the lamp the candle power is zero; under the bend of the filament it is less than four candles. This curve is of special interest as showing how a lamp is best placed for desk use, and that the practice of suspending a lamp vertically over the desk or table is not its best disposition. The candle power is indicated on the reference circles. This diagram should also make apparent that the usual lamp cluster with the single porcelain reflector over it is not the best arrangement of the lamps for lighting halls and rooms.

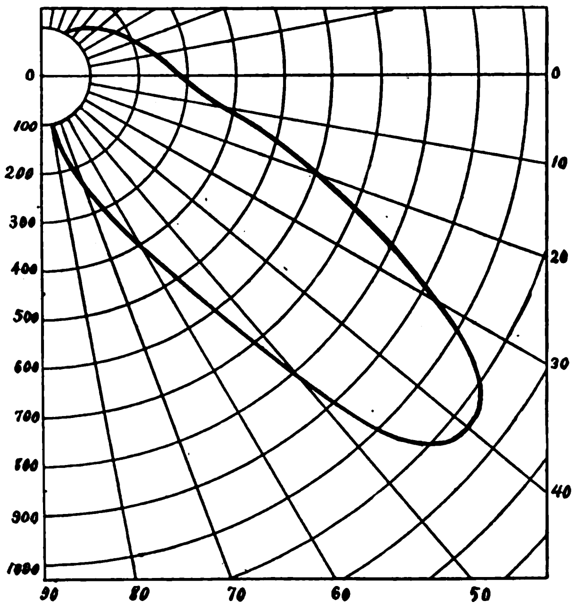

FIG. 3.

The arc lamp fed by a current of constant direction exhibits certain peculiarities of distribution radically different from those of other light sources. The light giving elements of the arc lamp are the hollow crater of the positive carbon tip, the cone of the negative and the incandescent carbon of the arc itself. The positive crater being the hotter gives off the bulk of the light; the negative tip is feebly luminous in comparison, while the arc may emit little or much light according to the nature of the carbons employed. But these three factors account not only for the light the arc produces but for its distribution as well. The light intensity curve in Fig. 3 may be taken as a typical case. The arc is supposed to be located at O, and from this point as a center the reference candle power circles are drawn. For sake of illustration the lamp may be considered as stationary while the photometer was swung around O as a center, in a vertical plane. This method can not be followed in practice, for obvious reasons, but the actual method employed will be described in detail in a subsequent paper. The radii of the figure represent degrees of inclination to the horizontal line through the arc. The candle power measured at these various angles was correspondingly platted to form the curve shown in the figure. In this case the maximum candle power, 1140, occurs at about 40° inclination. As a general statement the maximum candle power of the direct current arc is found at an angle of 45° inclination to the horizontal line through the arc itself. It may however, vary between 40 and 50 degrees. In our curve at 20°, the candle power has fallen off to 600 candles while at the horizontal line it is only 285 candles. Above the horizontal the candle power is very low. This curve enables us to judge approximately of the light emitting value of each of the three elements just referred to. If the arc is accurately centered on the carbons, the distribution of its light at any angle will be nearly circular. In practice the frame work of the lamp acts as a screen and the arc is rarely at the center of the carbon tips, and the carbons, themselves, are often far from homogeneous. As a result the light may be far from uniform on all sides. Such curves are of great value for indicating how an arc lamp should be placed for the most advantageous lighting of a room or street. A complete picture of the total distribution of the light about the arc may be formed by rotating the curve about the vertical line to the left, and allowing for the shadows due to the lamp frame.

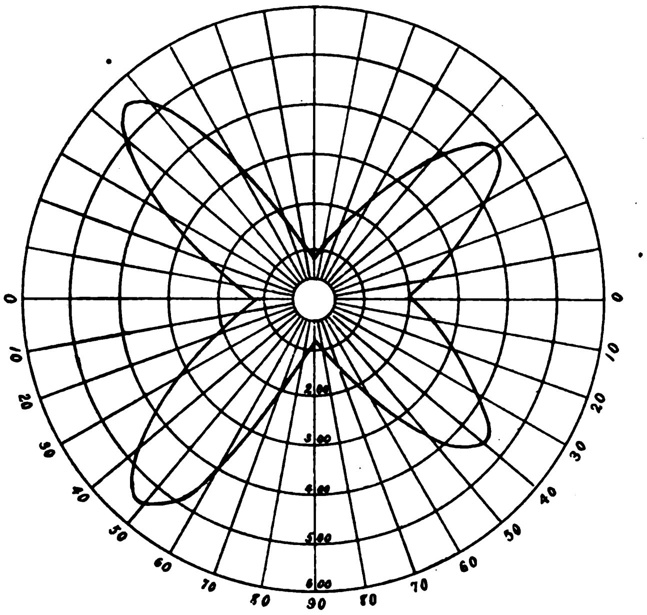

FIG. 4.

Such curves naturally suggest the discussion of the vexed question of the rating of arc lamps. Arc lamps are rated in nominal candle powers, a value that is meaningless when compared with the rating of incandescent lamps. As a result the practice of double rating has come into use, the 2000 nominal candle power arc, for example, being stated to show a certain actual candle power. As a matter of fact, the name, "2000 candle power" for a 450 watt lamp was given to it honorably and not as a misleading trade name, but this rating was taken from measurements made at an angle of 45° inclination. The terms "1,200 candle power," "2,000 candle power," etc., invariably refer to the intensity of the light given off at this angle. This designation, however, has always been misleading, and is still without any particular value. It is practically impossible to rate an arc lamp in terms of candle power, as is done in the case of incandescent lamps. A 450 watt arc may show 2,000 actual candle power, but as a rule it falls far short of this value. This uncertainty is caused by the feed of the carbons to some extent, but for the most part is due to the carbons themselves. Measurements of the candle power of such arcs give values ranging anywhere from 900 to 2,000 candles, and it is only with carbons of a certain size and of exceptional quality that 1,500 candles is exceeded. Large and hard carbons mean long life but low candle power. Another practice is to rate arc lamps by the watts absorbed by them. This is evidently the most rational rating, and though becoming quite general, it is by no means universally agreed upon. Such considerations as these are certainly suggestive and clearly point to the poor economy of using cheap, long-lived carbons.

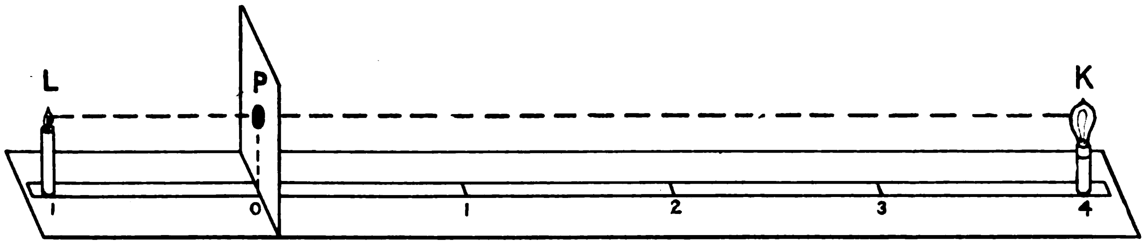

FIG. 6.

Historically, then, the names "1,200 candle power," and "2,000 candle power" arcs, originated from actual measurements made on the first arc lamps used. In this same connection the history of the standard sizes of incandescent lamps is of interest. They originated from competition with the gas burners in general use; the ordinary size, 16 candles, was adopted because it was the equivalent of the four foot burner with average quality of gas.

The alternating current arc lamp presents several additional peculiarities and a number of points not generally understood. The distribution of light about such an arc is shown by the curve of Fig. 4. This curve is ideal to the extent that the one is platted continuously, making no allowance for the shading of the frame. In practice the curve would be interrupted along the vertical diameter and be further modified by such reflectors as are used on the Helios lamps. It will be noticed that the distribution shows two maximum points at 40° both above and below the horizontal. The total distribution about such a lamp may be pictured by revolving the curve on the vertical axis at 90°. The reason for the peculiar distribution is obvious. On account of the alternations in the direction of the current, each carbon tip is in turn positive. With equal watts supplied an alternating arc will yield less light than a direct current one. The causes are: The rapid changes in the polarity of the carbon tips produce an equally alternating heating and cooling effect on the carbons, resulting in a lower average temperature with less light emitted; also, the current rises from and falls to zero value twice in each complete cycle, an influence which increases the cooling of the carbons. The relative light emitted by an alternating and a direct current arc is not able to be generally stated. The character of the lamps, the shape of the current waves and the period and the quality of the carbons as well, have each a marked influence on this ratio. It can only be determined with precision for each special case. Measurements show that the alternating arc emits all the way from 30 per cent. to 70 per cent of the light emitted from the direct current arc of equal watts. The distribution from alternating arcs is more uniformly diffused and so offers advantages for many special cases.

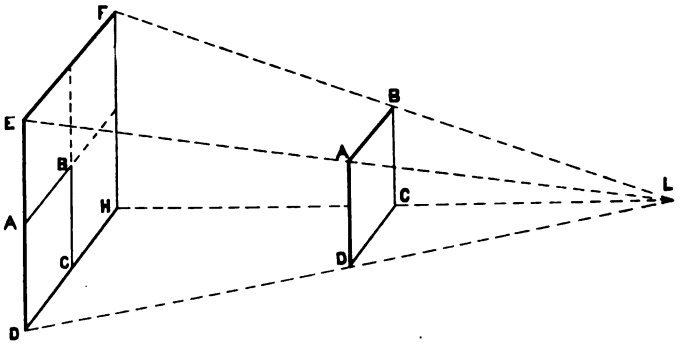

FIG. 5.

THE PRINCIPLES OF THE MEASUREMENT OF CANDLE-POWER.

For the sake of demonstration the soure of light is again supposed to be located in a point from which it emits light equally in all directions. In consequence, the surface lighted by any element varies in size as the square of its distance from the light source; or, in other words, the

amount of light falling on a square foot perpendicular to a line drawn from the source to it, varies inversely as its distance from the source. This is clearly shown by the diagram, Fig. 5. L is the point of light, and ABCD represents a square surface of one foot dimensions, at a distance from L of, say, five feet. DEFH is a square projected to a distance of ten feet from L. This latter square has then four times the area of the smaller one, but receives only the same amount of light would fall on the smaller square. A square foot of its surface receives thus, only one-fourth the light falling on the square foot surface at a distance of five feet. The light intensity on unit area is then the inverse ratio of the squares of the distances. This, in brief, is the principle of the photometer. An outline sketch of the ordinary Bunsen photometer is shown in Fig. 6. The standard candle is located at L, the lamp to be measured at K, while P is the reference screen. The centers of both the candle and lamp are placed on the horizontal line passing through the center of the small greased spot of the screen. In this case the standard candle is just one foot to the left of the screen, while the lamp is four feet to the right. In this position, suppose the greased spot to be equally illuminated from each side. This will mean that it is receiving on its surface as much light from the candle as from the lamp. Applying the the principles explained above the results may be written in a proportion,
$L:K=(1)^2:(4)^2$, or $K=L\times 4^2=16$ candles,
assuming that the candle is emitting a unit quantity of light.

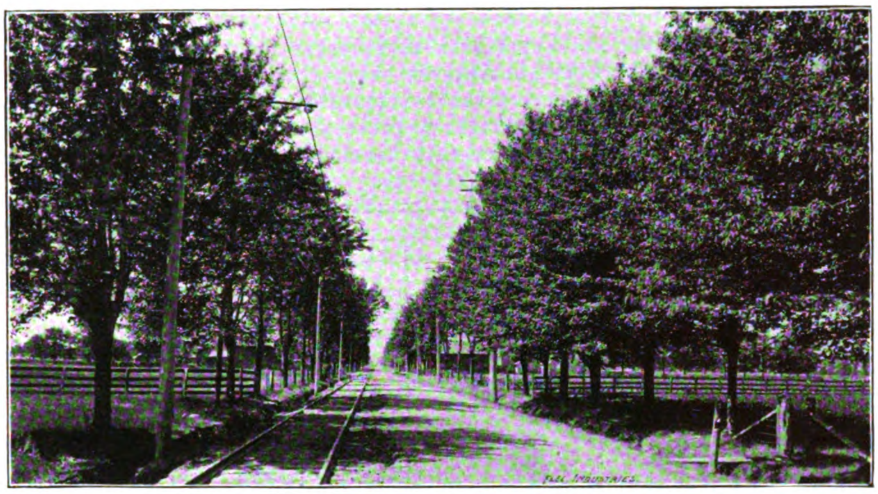

FIG. 1.—THE MT. CLEMENS FAST LINE: AN ELECTRIC INTER-URBAN ROAD—VIEW OF LINE 15 MILES FROM DETROIT.

Armour Institute of Technology.

Among the many electric railway lines that furnish transportation to the residents of the suburbs of Chicago and pleasure trips for the residents of the city, none can claim to be more wide-awake and alive to the advantages of its lines than the Calumet Electric Street Railway. The road connects with the lines of the Chicago City and the Alley L, and runs to Brookline and connects with the Oakwoods cemetery. A funeral train appropriately draped recently bore a funeral party from West Pullman to Oakwoods. Funeral trains can be furnished by this road that will carry the remains, family and friends quickly and economically from residence to cemetery. A car suitably draped for such a mission can not be objected to and where long distances are to be covered the cemetery can be reached as quickly and conveniently. The road has furnished special trains for trolley parties heretofore with success and in this new departure the road can unquestionably furnish a satisfactory service.

"I like the Industries very much."—S. J. Ross, engr.

The Mt. Clemens Fast Line; an Electric Interurban Road.

On Wednesday, September 18, the formal opening of the Mt. Clemens Fast Line, an electric road owned and operated by the Rapid Railway Co., was celebrated. The aldermen and other officials of the city of Detroit, joined with those of Mt. Clemens, in the formal opening of the road which unites the two cities by this most modern system of rapid transit. The road runs from Mt. Clemens, Mich., to Leesville, a suburb of Detroit, where connection is made with the tracks of the Citizens' Street Railway Co., of Detroit, over which the cars are run to the center of the city. Mt. Clemens and Leesville are seventeen miles apart in an air line, Detroit four miles from Leesville, making a run of 21 miles.

The road has attracted considerable attention, and a description of the road as completed will be of interest. Its patrons are well pleased with the equipment and service given. The ride is through a charming country, and combines the advantages of both a pleasure and business route. The road is now running eight vestibuled motor cars, mounted on double trucks and trailers. They were built by the Jackson & Sharp Co.. and are as easy riding as the steam coaches. The transverse seats and center aisle also add to the convenience and pleasure of the trip. Two 50-horse power motors and series parallel controller is the equipment of each car. A speed through the country of 35 or 40 miles per hour is often attained with two or three trailers. Although the road is single track and turnouts are often three miles apart the arrangements are such that close connections are made.

In this part of the service portable telephone sets are used, each car being provided with one. A telephone line is run on the opposite side of the road, on poles of the Bell company, and at frequent intervals waterproof pole boxes are installed, into which a loop is run. The plugs on the flexible cord of the hand telephone are inserted in the holes provided and connection is established with the dispatcher; who is thus kept posted as to the location of trains, and if anything should happen to equipment that department is quickly notified. A sketch of the telephone and pole box is shown in Figs. 4 and 5. This system has so far proved very satisfactory.

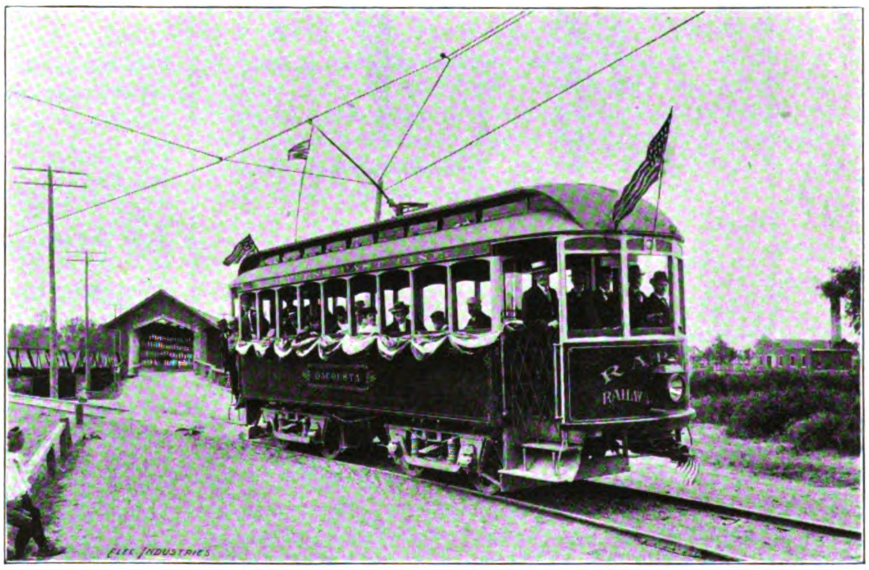

FIG. 2.—THE MT. CLEMENS FAST LINE; AN ELECTRIC INTERURBAN ROAD—MOTOR CAR ON ROAD JUST OUT OF MT. CLEMENS.

The cars are at present equipped with hand brakes, but it is the intention to place air brake equipments on each motor car. Each car has now a whistle operated by compressed air. The air is compressed by throwing the pump wheel in contact with the face of the car wheel, the lever for this purpose being operated by the motorman.

The track rails are seventy-pound steel tee rails, and the road bed is probably unexcelled by any line covering similar territory. The tracks run at the side of the road and the trolley is suspended from brackets in the manner shown in Fig. 1. The poles were carefully selected and the pole line is certainly a pleasure for the eye of any engineer. The rails are bonded with 00 copper wire, with ends riveted, and about every fifteen rails the track is cross bonded. The feeders extend seven and one-half and three and a quarter miles each way from the power-house. These are of 0000 copper, and are mounted on the cross arm on top of poles. These feeders will be supplemented in the near future by another running the entire length of the line. The Clinton river, near Mt. Clemens, is crossed by a steel trussed bridge, which is shown at the extreme left in the view, Fig. 2.

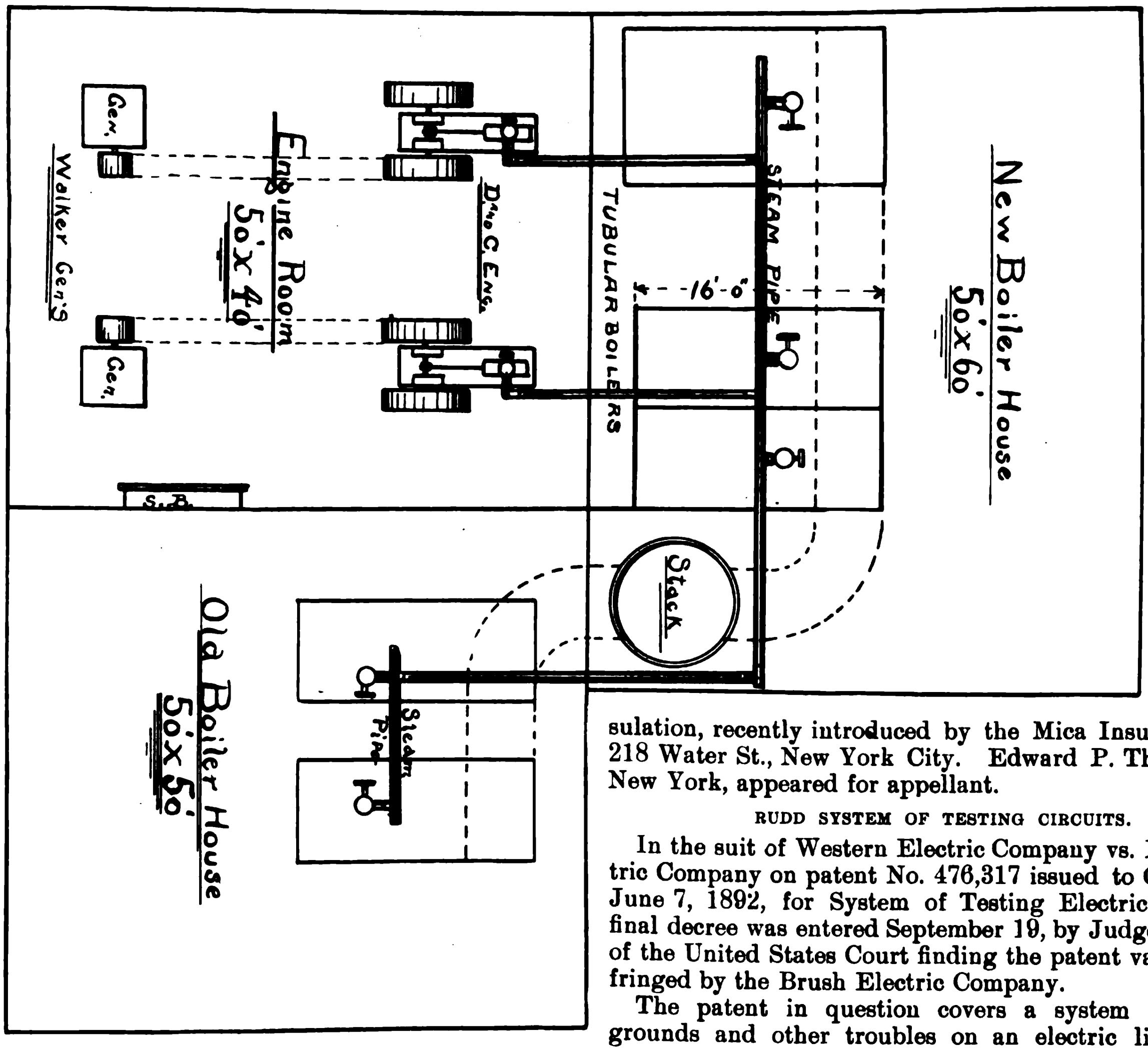

FIG. 3.—PLAN OF STATION.

The power-house, a floor plan of which is shown in Fig. 3, is located eight miles from Mt. Clemens. It is thus at nearly the center of the line, making the distance power is transmitted the shortest. The building is substantially constructed of brick, as are also the car barns, close at hand, with ample accommodations for the rolling stock.

The engine room contains two 300 horse-power Dick & Church engines, built by the Phoenix Iron Works, belted to Walker multipolar generators of 200 kilowatts each. The engine room also contains switchboard with instruments and such appliances as the requirements of the station make necessary. The boiler room contains 300 horse-power of Atlas tubular boilers, which are supplemented at times of heavier load by McNaull water tube boilers in an old power plant adjoining the station.

The road has been very successfully operated since it was opened, and the patronage has been much above what was expected. Combination smoking and express cars will be soon placed in service. Both the American and United States express companies desire to operate over the line, and it will probably also carry the United States mail.

The construction of this road and its successful operation is due to the admirable pluck of its promotors, Messrs. C. J. Reilly and Chas. M. Swift, respectively president and treasurer, of the Rapid Railway Co. The general manager of the road is Mr. Percy A. Clisdell. The superintendent is W. G. Wagenhauls.

Patent Decisions.

FLEXIBLE MICA—PATENT ALLOWED.

The Board of Appeals of the United States Patent Office has just reversed the decision of the Primary Examiner and has granted the right to protection upon what is appropriately and conveniently termed "Flexible Mica" for insulation, recently introduced by the Mica Insulator Co. of 218 Water St., New York City. Edward P. Thompson, of New York, appeared for appellant.

RUDD SYSTEM OF TESTING CIRCUITS.

In the suit of Western Electric Company vs. Brush Electric Company on patent No. 476,317 issued to C. H. Rudd June 7, 1892, for System of Testing Electric Circuits, a final decree was entered September 19, by Judge Showalter of the United States Court finding the patent valid, and infringed by the Brush Electric Company.

The patent in question covers a system of locating grounds and other troubles on an electric light circuit which consists in providing an artificial circuit of high resistance at the station and adapted to be connected to a line circuit, the resistance of the artificial circuit being fixed and so apportioned between contact points that the attendant, by means of a testing set, may find the neutral point in the artificial circuit corresponding to the neutral point of the line circuit connected therewith.

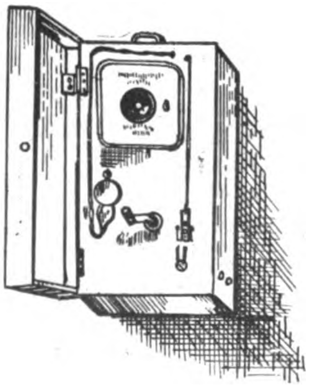

FIG. 4.—TELEPHONE.

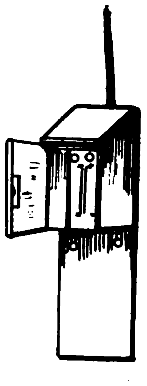

FIG. 5.—POLE BOX.

Factory Practice in the Design and Construction of Dynamos.—V.

BY C. E. WOODS.

There is probably no set of figures compiled in the process of proportioning up a machine which have to be carried out so accurately, in order that results may equal the determination, as those of the field winding, and it is probably one of the most unsatisfactory portions of the work as regards mathematical predeterminations, and finished results. Experience and judgment in connection with this will always give a margin for a factor of safety, inasmuch, as in determining the total resistance of the shunt circuit the resistance of the rheostat to be used is deducted from the total resistance of the same, which in case of error will allow an increase of 25 per cent in the current. The cause of a considerable variation lies principally in the length of the air gap; if we have a total air gap length of one-half inch which calls for a specific number of ampere turns and this length was made in construction five-eighths of an inch, it would call for just that percentage more of ampere turns, or if made three-eighths of an inch for that percentage less in ampere turns, so it will readily be seen that even a small fraction of an inch variation in length of the air gap will have a very material effect on the ampere turns required.

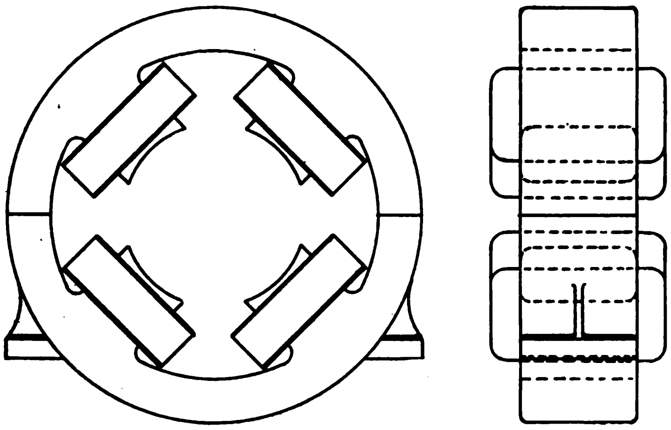
FIG. 12.

In a motor this is much more patent than in a generator for the reason that we do not have to use a rheostat in the shunt circuit, and experience teaches that the best method of procedure in a new type, or new size of machine for use as a motor is to make an allowance of at least 20 to 25 per cent more ampere turns for the field winding than the actual results of the formula may call for, for it is preferable to have a trifle too large space allowed for a field winding rather than not enough.

If, upon completing a motor, the speed shall be found to be too low, the remedy is indeed a very small affair; a removal of some of the ampere turns, or an increase of the the length of the air gap, by boring out the field a trifle larger, is all that is required to increase the speed of the motor; either methed of procedure resulting in a weakening slightly of the field; as we all know if a rheostat is inserted in the shunt winding of the motor the speed will increase as the resistance of the shunt circuit is increased, and in a new type or size of motor the most satisfactory result in the preliminary test that can be obtained is to have the speed fall short, if anything, of the actual determinations called for in the preliminary computation. Should the speed of the motor be higher, by any great amount, than given in the set of specifications, it would certainly show a lack of experience and judgment in proportioning a machine. Such a result is indicative of too small an amount of material and cannot be remedied except by an increase in the number of armature conductors, or an increased field strength, and if the space allowed for the field windings is already filled this latter method will, of course, be out of the question; increasing the number of conductors on the armature would mean a smaller sized conductor with a correspondingly small capacity for labor of the motor.

Upon first testing a machine for a motor it is well to give it its specific speed as a generator and take from it a saturation curve similar to the one shown in Fig. 10, which is a very simple thing to do. The machine being put to speed a large variable resistance is inserted in the shunt circuit, say, 3 or 4 rheostat, such as might be used there, with an ammeter in series with the same; the brushes are adjusted to the right point, but no load should be thrown on to main circuit; a voltmeter, only to be attached one terminal of it to either brush, with the shunt circuit open, a reading of the voltage should be taken which is generated by residual magnetism, that is, the magnetism which remains permanent in the iron; after which the current is turned on to the field, if possible, from a separate exciter, or, in other words, the current from another machine should be used to excite the fields of the one to be tested; take smallest current possible, say one-quarter to one-half ampere, and note voltage on voltmeter, and so continue for every one-half ampere until at least the voltage that the machine was designed to run at is obtained; but it is better to go at least 50 per cent beyond this in order that the curve may be shown well beyond the point of saturation. Having obtained the voltage of the machine at every increased ampere, or one-half ampere, lay off on a piece of cross section paper the amperes across the bottom of it, and the corresponding voltage from the lower left hand corner up towards the top.

In Fig. 10 the voltage is very high, being from an arc light machine, but the method of procedure would be identical with this. As the dots are laid off the voltage always coming at the junction of the amperage for a curve, it can be very easily ascertained at what point of saturation the iron in the machine is being worked out, and in drawing a deduction for the operation of the machine, either as a generator or a motor, this, of course, will be the sole guide to work from. Should the machine be found to work at a given speed much below the point "A" either one of three things can take place to remedy it; the speed can be lessened to carry the voltage higher up the curve, or the number of conductors in the armature can be lessened to accomplish the same result, and again, the air gap may be increased which may sometimes be found necessary in the case of a generator in order to increase the spark limit; sometimes when a machine has been designed and completed it is found that it will spark at the brushes before the maximum load is reached, necessitating the moving of the brushes forward a trifle to overcome the sparking. By increasing the air gap it is found that a greater load can be put upon the machine before this spark limit is reached, and a true balance of the machine is when the air gap is such, with a given field winding, that about 10 per cent over the rated capacity of the machine can be carried before sparking takes place at the brushes.

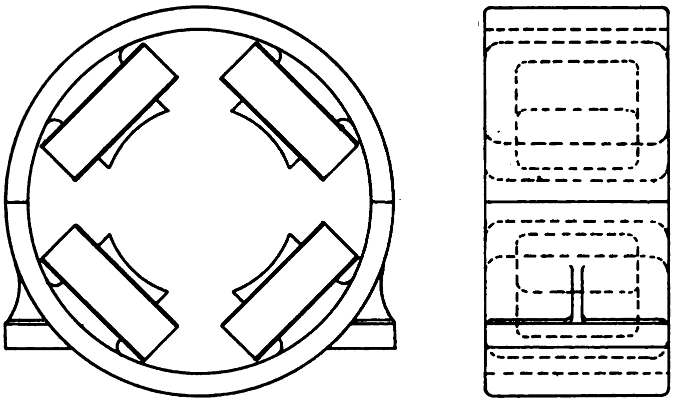
FIG. 13.

In bipolar machines it is almost impossible, without making a machine very much larger than need be, to obtain this result at all, owing to the leakage of the fields in such machines, and the inequality of the magnetic distribution through the armature core and field circuit, but in multipolar iron clad machines it is found that this works out very correctly, and from this advantage as well as several others there is little question but all forms of motors and generators will be constructed in a multipolar form. As a matter of fact some of the larger companies are now running these sizes down to one horse-power.

We have now reached a point in our calculations where we have to take under consideration the mechanical proportions of our machine, and this is purely a question which is hinged on cost of production; that is, we must get the best result in appearance and mechanical operation with the least amount of labor in tooling, etc., as well as with the least possible amount of material consistent with good construction. Our field will, of course, be a specific mass, shape and size, and will be made circular in form with poles projecting inwards as illustrated in Fig 4, with lugs on the side for bolting same on to the base. This can be made in two ways for a finished appearance: the ring can be the same width and half the thickness of the poles as in Fig. 12, or may be made thinner and lap by the poles on either edge sufficiently to cover, or project as far out as the field coils extend over same, which will be the same as from "X to Y" Fig. 11, or two and a half inches. It is preferable to round off the outer corners, but that will make but little difference one way or the other. We next have to consider the form of our base, sub-base and journals.

Sparking at the Commutator.

BY A. W. FOSTER.

To avoid continuous interruptions in the production and transmission of the electric current as applied in the arts of the present age has been no small task. As a result of investigation along this line new fields for improvement have been opened, and with it the rapid development of a power the growth of which even today exceeds the most sanguine hopes of the original investigators.

All the earlier electrical transmission has been done by continuous currents. This type of apparatus will still continue to be installed on an extensive scale, for in many cases the direct current proves as economical as the alternating, but it must be confessed that no alternating apparatus has yet appeared able to compete under all conditions with the direct current machines. The practice of installing alternating and polyphase apparatus is almost absolutely necessary in many instances. In the latter forms of electrical transmission the commutator performs but a minor part, hence this article will be confined to continuous current apparatus, wherein the commutator becomes a comparatively complicated structure.

Perhaps sparking at the commutator has been one of the greatest of the many problems to eliminate in the designing of electrical apparatus. It is an admitted and well-known fact that heating first limits the efficiency of modern machinery. It is therefore needful to suppress so far as possible that which produces heating effect. The following are some of the causes which produce heating and excessive sparking: (a) Friction in bearings and brushes; (b) insufficient pressure of the brushes against the commutator; (c) too great pressure of the brushes against the commutator; (d) the polished surface of carbon brushes against the commutator; (e) powerful currents set up in the short circuited coils undergoing commutation.

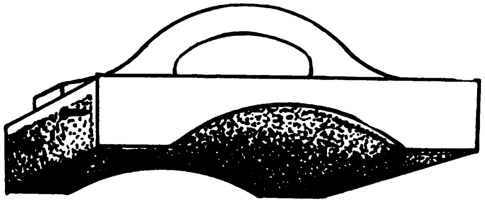
FIG. 1.

Heating tends to limit the output, but the output of a generator is not really limited by the excessive sparking, for the armature is usually so constructed that the temperature elevation fixes the limit to the output before the sparking becomes troublesome. Many ways were suggested and practiced to obviate sparking, with but little success, until the difficulty was overcome so far as designing of the generators was concerned, by the successful application of tooth-covered armatures, the advantages of which are many, and give less trouble from sparking than smooth-cored armatures, the teeth being not only of mechanical, but also of considerable electrical advantage. It is not our intention to enter into the discussion of the different forms of armatures or commutators on the market, but rather to advance a few thoughts which, we trust, will benefit the operators of plants already installed.

For the successful operation of any machine of importance, it must be well designed and constructed; but it happens that hundreds of well designed and finely constructed machines are thrown out or fail to operate as well as they should, because of the employe's neglect; or in not knowing at the time the correct remedy to eliminate trouble. If the solution of the problem is due to ignorance, it is time the employe be made master of that which he is employed to operate, by receiving just consideration, and made the recipient of information that is generally retained by the designer and manufacturer. Divulge to the employe any points of peculiarity and reduce interruptions to a minimum. If this custom were universally practiced there would be a marked difference on the disbursement side of the ledger of some of the largest, as well as the small power and lighting plants.

If the commutator should be worn in ridges, or rough, grind down with No. 1 sandpaper held in a block of wood curved to fit the commutator, as shown in Fig. 1. The advantage of using a block of wood curved to the radius of the commutator, is that it tends to smooth the high points, and does not round the surface of the individual bars, as do the leather strip and sandpaper stretched across block of wood. If the paper is saturated with engine oil, or a piece of canvas is held back of the sand block, all particles of copper dust will adhere to their surface, and prevent the dust from lodging upon the generator. If out of round or too bad to grind down, turn off light cuts with special lathe attachment—never attempt to true up a commutator with temporary wood frame work; of course, this can be done by a skilled workman. High or low bars which cause the brushes to jump can be remedied by tightening the clamping rings and trimming down the high bars, or in case of low bars turning the commutator down to their surface. The high bars, although susceptible to injury, can be adjusted by mallet.

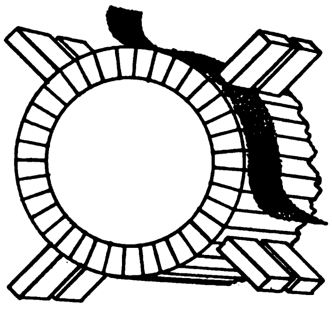
FIG. 2.

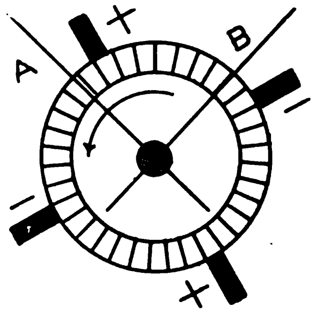

FIG. 3.

A dynamo brush is one of the most important factors in the success of electrical generators and motors. Many different types of brushes have been produced, which would be worthy of mention, but, for limited space, so we shall confine ourselves to the proper care of the carbon brush. They are universally for both generator and motor, serviceable and economical alike, preventing a large wear on the commutators.

Use proper care where carbon brushes are employed to obviate the tendency of sparks to flash around several segments of the commutator, as it is accompanied by heating, and usually the result of carbon dust getting into the insulation between the segments. The only suitable remedy is to clean thoroughly.

When a generator or motor is operating under a light or heavy load, the excessive sparking of carbon brushes of ample carrying capacity in amperes—and in good electrical connection with the brush holder—perfect fitting surface upon the commutator, is due to the polished surface of the brushes made so by friction. The resistance of such a surface produces undue heating and sparking. If the generator is operating under a heavy load the points of the brush conducting the most current will be heated to glowing red, and will continue so until burned off or worn down; in like manner other portions of the brush are heated without cessation until the efficiency of all the brushes are decreased.

Many remedies have been suggested and tried to eliminate sparking due to the brushes, such as adjusting tension, altering the lead, soaking the brushes in oil or in paraffine, using paraffine upon the commutator. The only practical and known way to insure good electrical contact between the commutator and brushes of carbon, is to remove the polished surface from the brush by sandpaper before or after every run. Fig. 2 shows the manner of sandpapering without removing the brushes from the holders when the generator is not in operation. Use a strip of sand paper somewhat wider than the brush to be sanded, place it rough side up, and pull it back and forward few times; care should be taken to keep the ends of paper close to surface of commutator to avoid rounding the edges of the brush. By sanding in this manner, the surface of all the brushes will coincide to the radius of the commutator, and will insure perfect contact.

When the generator or motor is operating, perhaps the sand block will be found too bulky to use: if so, the frequent use of sand paper held against the commutator just back of the brushes shown at A and B, Fig. 3 will produce a clean and polished surface which is absolutely necessary for perfect conductivity.

The life of a well-constructed commutator should be as long in proportion to the work depending upon it, as any part of a generator or motor; but it is true the commutator when in its best condition is a troublesome and difficult piece of mechanism to operate.

Definitions Wanted.

A correspondent writes: "Will you please define in your valuable journal what are to many people, quite justly, I think, the vague terms, 'fire surfaces, heating surfaces, and boiler surfaces?'

"In my opinion the fire surface is that portion of a boiler which comes in direct contact with the fire.

"The heating surface is that portion of the boiler which is actually against the coal or liquid fuel, while the boiler surface seems to me to have the broad meaning of every part of the boiler, whether in the fire or out of it."

It seems doubtful to us whether any of these terms excepting heating surface has any exact meaning assigned to it. Any portion of the internal or external surface of a boiler through which heat is transmitted from the fire to the water is generally regarded as heating surface, although Seaton, in his book on the "Marine Engine," says that, "strictly speaking, all surfaces exposed to heat which are capable of absorbing, and their bodies of transmitting, that heat to the water or steam are heating surfaces; but technically only certain parts are reckoned as effective heating surfaces, and the aggregate of such surfaces is called the total heating surface. The surface of the upper half of the furnace, or the part above the level of the fire-bars, that of the combustion chamber above the level of the bridges, and the back plates, including the actual surface of the back-tube plates, are reckoned as the effective heating surface of furnaces and chambers, and are stated separately, chiefly on account of the metal forming them being three or four times the thickness of the tubes."

Robert Wilson in his "Treatise on Boilers," says: "In estimating the extent of heating surface it is customary to take the whole area of furnace, combustion chamber, flues, water-tubes, etc., in contact with the heat on one side and the water and steam on the other."

Fire surface, so far as we know, has no exact meaning, although it seems as though it should mean that surface through which heat is transmitted directly from the fire to the water, either by contact or radiation.

Boiler surface may mean either the external or internal or any other portion of its surface.—American Engineer.

"Your paper is one of the best published."—J. S. Hill, Gen. Mgr. LaFayette, (Ind.,) St. Ry.

Reports From the Conventions.

STREET RAILWAY ASSOCIATION OF PENNSYLVANIA.

The fourth annual meeting of this association was held at the Armory, Wilkesbarre, Pa. on Sept. 4th and 5th. The delegates, numbering over one hundred, were welcomed to the city by Mayor Nichols who gave the opening address. Among the subjects discussed were: "Power Consumption of Electric Railways" by A. K. Balor, "The Laws of Street Railways," "The Prevention of Accidents and the Adjustment of Damages," "Belt Lines in Inland Cities" and "State and Municipal Taxation of Street Railways." A number of entertainments were arranged and enjoyed. The election of officers resulted as follows: President, B. F. Meyers, Wilkesbarre; secretary, S. P. Light, Lebanon, and treasurer, W. H. Lanius, York.

CANADIAN ELECTRICAL ASSOCIATION.

The fifth convention of the Canadian Electrical Association was held at Ottawa on Sept. 18, 19 and 20. The meetings were held in the Tower room of the House of Commons. The delegates were welcomed to the city by the Mayor. The president's opening address reviewed the advancement made in the past year and the possibilities that were before the industries which the association represents. The papers of the convention were: "The Telegraph in Canada," by C. P. Dwight; "A Non-Interference Duplex Relay," by D. H. Keely; "Suggested Forms in Electric Light Accounting," by D. R. Street; "Some Modern Alternating Current Apparatus," by H. T. Hartman and "Some Notes on the Consolidation of Two Systems of Electrical Supply," by A. A. Dion. The social features of the convention were not neglected. The banquet at the Russell House on Wednesday evening, was a magnificent affair. The decorations were grand and showed what can be done by way of decoration with the incandescent lamp. The officers for the year are: President, A. B. Smith, Toronto; vice-president, C. B. Powell, Ottawa, and secretary and treasurer, C. H. Mortimer, of Toronto.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

The thirteenth annual meeting of the Street Railway Association of the State of New York was held at the Albany, N. Y., Y. M. C. A. rooms on Sept. 17 and 18th. The convention was called to order by the president, Mr. G. Tracy Rogers, of Binghamton, N. Y., who delivered a very interesting address. The reports of the committees showed a very successful year's work. Among the papers read were, "Are we Laying Too Many Miles of Track to Reach a Few People?" by W. W. Cole; "Economical Equipment and Operation of Power House," by H. S. Newton; "Is a Freight or Mail Service Profitable or Unprofitable on Street Railways," by Benj. Norton; "Car Heating by Electricity," by J. F. McElroy; "General Track Construction," by C. L. Allen and "Signals on Electric Railroads," by J. H. Barnard. The meetings were well attended and at their close visits were made to many points of interest about the city. It was considered one of the most successful of the conventions of the association. The officers elected for the coming year are as follows: President, G. Tracy Rogers, Binghamton; first vice-president, W. W. Cole, Elmira; second vice-president, John H. Moffitt, Syracuse; secretary and treasurer, Benj. Frick, Brooklyn.

Sealing Champagne Bottles.

M. Villou, a Frenchman, has devised a method of sealing champagne bottles electrically. When the bottles are ready to be sealed the tops, as far as it is desired to cover them, are covered with a light layer of some conducting substance, such as plumbago. The tops, including the corks, are then immersed in an electroplating tank where they are plated with a covering of copper. The bottles are arranged in a frame which is so constructed as to connect all the bottles with electrical conductors which lead to the plating dynamo. The copper sheets in the tank are connected to the other pole of the dynamo. The process is said to be equally applicable to sealing any glass receptacles.

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Notices or other matter will not be inserted for pay in any except the pages devoted to advertising. Descriptions of appliances, etc , will be published only as they possess novel and interesting features.

Communications on subjects of interest for insertion in any of the departments of the paper will be accepted for publication at the discretion of the editors. Articles from practical men on subjects relating to the construction, design, care and operation of electrical appliances are especially desired. Information of interest regarding new projects, new inventions or new applications of electricity is also solicited.

To unwrap your paper, pull out the string which you will find in the wrapper.

This is the season of conventions. The time of the year most favorable to their success. The excessive warm weather of the summer has passed, vacations are over and every one has again taken up his business, rested and invigorated. Travel is at no time pleasanter nor more conveniently accomplished. Hotels have less terrors to the home dwellers, since it is the season when the markets offer their richest stores and the temperature reaches neither extreme.

During the past month a number of associations representative of the street railways of the several states have convened, transacted their business and adjourned for a twelvemonth. The telegraphers have renewed old acquaintances and discussed future prospects. The Canadian Electrical Association, in its fifth annual convention at Ottawa, has taken up in discussion matters of importance to the electrical interests of Canada; the electro-therapeutic association at its Toronto meeting listened to reports and interesting papers; the association for the advancement of science held one of its usual interesting conventions last month and the National Association of Stationary Engineers, held a large and successful convention at St. Paul.

The benefit of these associations to the industries and classes they represent is generally acknowledged, but how is it about the individual member of this industry; does it benefit me or you personally? Is it to our best interests to attend these meetings of our association, to participate in its proceedings, to add to its success and to share in the expense as well as the profit? When we are at home we learn something about what our neighbors in the next town are doing, but only in a general way. It is not like a face to face meeting, a discussion in which all can take part, and an opportunity to discuss others needs as well as our own. The latest ideas concerning the interests of the association are presented, enabling us to be prepared so as to take advantage of any change or inprovement. Competition is present in almost every line and in most cases just in proportion to our ability to meet it, are we successful. The convention gives us an opportunity to learn of new competitors, or what is liable to be a competitor, and also an opportunity to learn how to best meet it.

This month the convention of the American Street Railway Association is held at Montreal. Every effort is being made to increase the attendance and to make it the largest and most successful meeting in the history of the association. The program has been slightly changed from the usual order to allow a more general discussion of the subjects which are now of most importance to the street railway manager. The usual exhibition of street railway appliances will be held and every opportunity will be afforded for the display of the appliances and apparatus under working conditions. It is the intention of the directors to make both the meetings and the exhibition instructive in character.

Many short processes have been devised for the production of white lead, but, as a rule, they have failed to produce a pigment equaling that made by the slow Dutch method. This method requires several months for its completion, large works and the product is therefore proportionately expensive. Could the various steps be made quickly, so that as fine a quality could be turned out in as many days as months are required by the old method, the cost would be greatly reduced. That such a method would therefore have a great value will be at once evident. Mr. R. P. Williams, in a paper read before the American Chemical Society at the Springfield convention, describes an electrolytic process invented by Mr. Arthur G. Brown. This process, as he describes it, consists of four reactions: First, the electrical preparation of nitric acid and sodium hydroxide; second, the action of nitric acid on lead, forming lead nitrate; third, the reaction of lead nitrate and sodium hydroxide to form lead hydroxide; fourth, the combination of lead hydroxide and sodium bicarbonate to form lead carbonate. To produce these reactions, the electric current is used. Pig lead is used, as it comes from the furnaces; impurities are removed in the process, and the result is said to fully equal in every respect white lead made by the old method. Samples of the electrolytic and of the Dutch leads were exposed side by side for two years to the extremes of weather and other trying tests, but no difference would be detected between the two. Lead carbonate appears in two forms, the crystalline and the globular forms. The former will not absorb oil to anything like the extent of the latter. Other properties also cause the use of the one and the disuse of the other. The electrolytically produced white lead is of the globular form, and, it is claimed, is in an even more finely divided state than that produced by the Dutch process. If this new electrical process is the success represented, electricity will again have revolutionized old and established industries, and added to the wealth of the world as modern inventions and discoveries are constantly doing.

There was celebrated in a western city last month the completion of a project which is in several ways remarkable. The long distance transmission of electric power developed from a waterfall has been one of the most promising dreams of electrical engineers and it was the realization of one of these dreams that was celebrated last month. Experimental lines and equipments had previously been constructed which demonstrated that the long distance transmission of power was possible so far as the construction of the lines was concerned. They did not, however, prove the commercial side of the question. From the success of the shorter systems and careful estimates based thereon it was shown as nearly as possible what the results would probably be. The capital was provided and the work pushed to completion. The plant will transmit four thousand horse-power twenty-three and one-half miles, delivering in the form of electric power the power of the stream miles away. The successful completion of this project, one of the first of its kind, is worthy of all the attention it has received. Future developments and discoveries may bring forth great improvements in the present system but it will always remain remarkable as one of the first of the long distance systems constructed.

Oil engines are coming into more general use in the United States, where they have not previously received as much attention as in Europe. They are being used more particularly in small power plants, for driving the dynamos in isolated and lighting plants, for pumping stations requiring but a small amount of power, etc. There are also a number of large stations using them and several electric plants run by gas companies have adopted the gas or oil engine in place of the steam engine. When first introduced there were a number of weak points in their construction which required frequent repair and more or less attention. Recent improvements have remedied these defects so that the later engines run more steadily and are not so liable to get out of repair. The slight attention required by the engines of this class make them especially desired when but a small amount of power is used, not sufficient to permit of the expense for an engineer. The many automatic devices which can be used in connection with such plants has greatly reduced the amount of attention which is demanded. The total amount of labor can in most cases be performed within an hour each day.

To some a carbon is a carbon, no matter what its qualities may be for producing a good light in an arc lamp, and yet the light of the lamp depends upon the quality of the carbons used. The cheapest carbons are often purchased because they are cheap, without a question being asked as to their light-giving qualities. Sometimes the purchasers looks only to the life of the carbon, preferring a slow burning carbon thinking that in this way be will reduce the supplies account and increase the net earnings of the plant or lower the cost of his lights. The plant is constructed, the coal purchased, burned in the furnaces and transformed into electric power for the light which it will produce in the arc lamps. The coal is carefully selected, the firing is watched, the engines and generators of high efficiency transform the power with the least loss and the circuits are constructed so that as near as possible to the full energy of the coal will be delivered at the lamps. If the carbons are not the best the whole effort toward efficient results are lost. It is, therefore, of the greatest importance that the carbons be selected with reference to their light-giving qualities in the arc lamp. Although hard carbons burn longer they do not give as much light as the softer carbons. In the light of arc lamps a difference of more than fifty per cent is often made by the carbons. The same amount of energy is consumed, the same amount of coal is required in the furnaces, but the result in one case may be twice that of another. When the plant is most carefully managed and good results are there obtained there is this final transformation of the energy of the coal that needs most careful watching.

There are many kinds of thieves in the world and many degrees of culpability in thievery. The half-starved child who steals a loaf of bread in its desperation and misery is universally pitied, not blamed. The able-bodied man who cannot, in hard times, find work to do, is punished, indeed, for an attempt to maintain life at the expense of others, but sympathy for him is not wholly withheld. The daring and ingenious burglar who schemes for months to rob a bank and who gains his ends, if at all, at the deadly risk of life and liberty, often commands admiration almost as much as fear. The sneak thief is the coyote of the kingdom of thieves—shunned and despised by all, even of his own general species. But what can measure the utter contempt felt by every right-minded and honorable man for that form of sneak thievery which involves the betrayal of trust—such a thievery, for example, as is committed when "commissions" upon purchases for corporations or firms are sought for or accepted by the purchasing agent? How can such thievery be justified to the consciences of men who are sometimes (though not often, we fear) proof against most other forms of temptation. They know, and must of necessity know, that whatever moneys are paid to them by a manufacturer are really taken out of the pocket of their own employers. They know, and must of necessity know, that no official action by themselves which cannot be frankly told to their employers can be manly or honest. They know, and must of necessity know, that however upright and honorable they may appear to be to the world at large, they are nevertheless despised by, and are actually in the life-long power of the men who are using them as catspaws, and who, among their own associates, do not hesitate to openly and contemptuously sneer at these "takers of commissions" as the "thieves," which they really are. How any man, however weak, can be drawn into such a position as this we do not see. Detection is sooner or later absolutely certain. Such things cannot permanently be concealed. Too many people are cognizant of the facts, and the criminal once detected is branded for life.

There is another side to this question, and one, which, while it is not an excuse, is perhaps oftentimes a reason for the acceptance of commissions. The large number of trained and partially trained engineers who have flocked into this street railway field during the last few years has made the conditions of competition for positions with street railway companies such that the salaries paid are too small for the service rendered. These young men are often well educated and have expensive tastes, together with some social standing and aspirations. Where this is the case they are received cordially in cities to which they go, and it is generally supposed that they are receiving salaries commensurate with their abilities. Under these circumstances, the temptation to add to income by "doing what everyone else is doing" may easily become too great to be resisted. What is true of engineers is true also of street railway managers themselves in too many cases—that is, they are not paid salaries equivalent to the cares and responsibilities which are placed upon them, nor sufficient to overcome the temptation to make up these salaries in an illegitimate way. The remedy lies with the street railway companies, and it may be said, broadly, that the money saved in salaries may be taken from another pocket many times over.—Street Railway Journal.

An Important Electric Railway Power Station.

BY H. C REAGAN, JR.

The proper designing of a power house for an electric railway so that it shall meet every requirement, involves experience, skill and a full knowledge of the conditions on the part of the engineer in charge. In the preliminary plans for the power house there should be considered: First.—The location with reference to its fuel supply and also the distribution of power over the lines. If the power house can be located on a railroad or waterway the cost of fuel is reduced by the expense of handling the fuel and in the latter case if condensing engines are used water is at hand for such purposes. Second.—The design of the station, considering both present and future needs. Third.—The proper installation of the best machinery adapted to the conditions of the road for which it is erected.

How well the power house of the Hestonville, Mantua & Fairmont Passenger Railway of Philadelphia, fills these considerations will be seen from the following description. The work of equipment was done under the direction of the chief engineer, Mr. A. Langstaff Johnston.

The power house of this road is located on the Schuylkill at 25th and Callowhill sts. As will be noted in Figs. 2 and 4 the building is handsomely designed and required in its erection special construction, particularly in the building of the foundations. It is 152 by 112 feet. The material used in the walls up to the engine room floor is Hummelstown brownstone. Above this they are of brick with terra cotta trimmings. The window and door sills are a cream colored sandstone. The roof is slate, supported on iron trusses. A large lantern is provided as shown to give light and ventilation. The interior walls are painted white which makes the engine room very light in every part. Fig. 4 shows a view of the foundation which places the basement floor above the reach of high tide.

The boiler room is situated on the east side of the building. It is contains eight 250-horse power Babcock & Wilcox watertube boilers arranged in batteries of two each. The fronts are built of enameled brick and the steam fittings are of brass. They consequently present a very clean and handsome appearance. The smoke flue extends the entire length of the division wall between the engine and boiler room and opens into the stack, which is 12 feet square.

The boiler feed pumps are located in the centre of the boiler room, between the boilers. The method of piping is shown in Fig. 3. In connecting up these pumps the piping was so arranged that the water can be pumped either direct to the boilers or through the feed water heaters, the water being taken from the hot well as shown. The Barryman feed water heaters are 1,000-horse power capacity each and are placed along side the boilers.

Piping: In piping this power plant one point was kept in view—the reduction of the amount of piping, elbows, turns, etc., as much as possible to prevent water traps. The main steam pipe from the boiler, as it will be noticed, makes a long, easy bend, passes through the partition wall and enters the distributing steam main. From this main the steam pipes lead to each engine. In each of these pipes near the steam main there is a quick stop valve by means of which steam can be shut off when it is necessary to repair engine or throttle valve. A seven inch steam pipe leads to the low pressure cylinder, so that in case anything should happen to the high pressure the engine can be run by the low pressure cylinder. There is a reducing valve in this pipe to keep the power normal. The exhaust pipe from low pressure cylinder has the usual stop valve so the exhaust can be passed into either condenser or atmosphere. The height and curve of the pipe from the boiler will allow any water of condensation to find its way back to the boiler by gravity. The pipes are of liberal area and steam has a clear passage from boiler to engine. The pipes are also covered.

The condensers are located under the floor as indicated in Fig. 3, and take water from an 8 by 8 foot well located at the center of the basement. They are of the Deane Independent type. The well is supplied by two Worthington duplex pumps having a capacity of 20,000 gallons each. One is held in reserve in case of accident to the other. The water is taken from the Schuylkill river, which supplies a well within the wharf line protected from ice and refuse. Connection can be made with the city mains quickly should anything happen to this source.

Coal handling: The coal is brought to the power house wharf by boats. The boats are unloaded by an elevator and coal conveyor supplied by the Link Belt Engineering Co., which places the coal in a bin holding about 300 tons. From this bin the coal falls through chutes in front of each

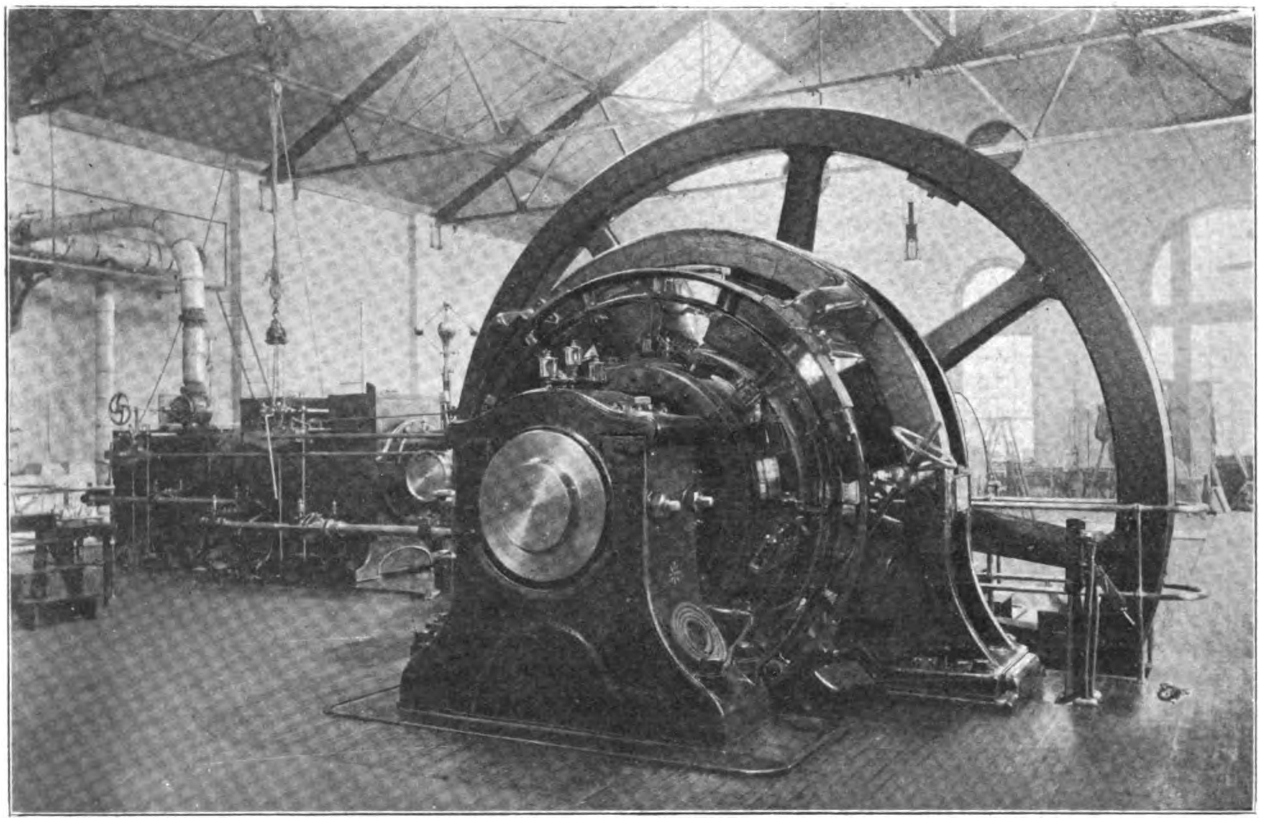


FIG. 1.—AN IMPORTANT ELECTRIC RAILWAY POWER STATION.

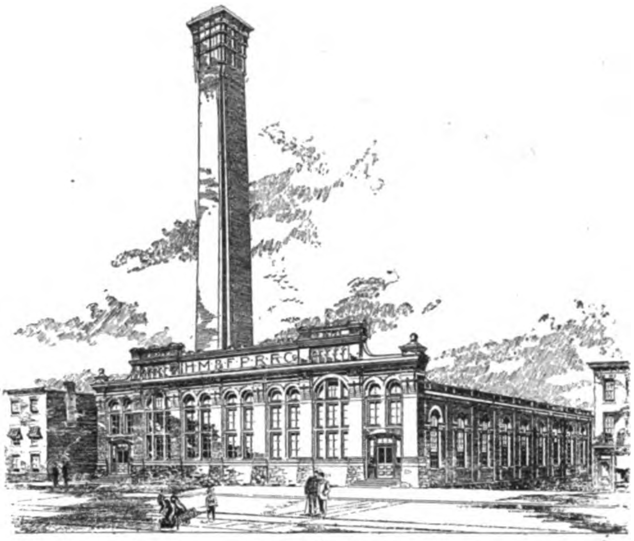


FIG. 2.—EXTERIOR VIEW OF STATION.

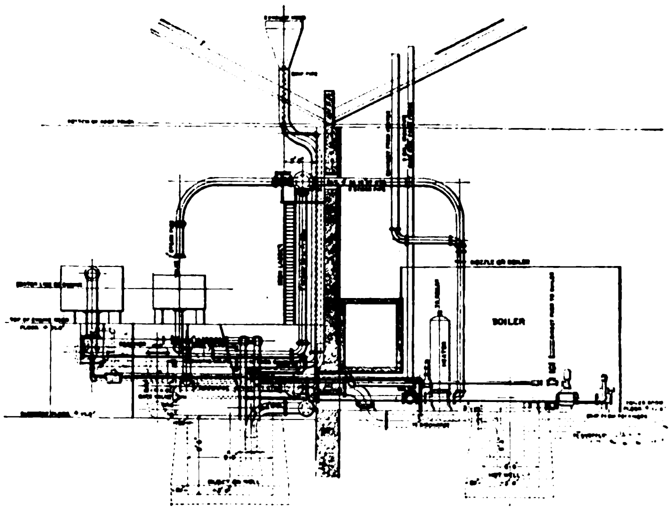


FIG. 3.—ELEVATION, SHOWING STEAM CONNECTION.

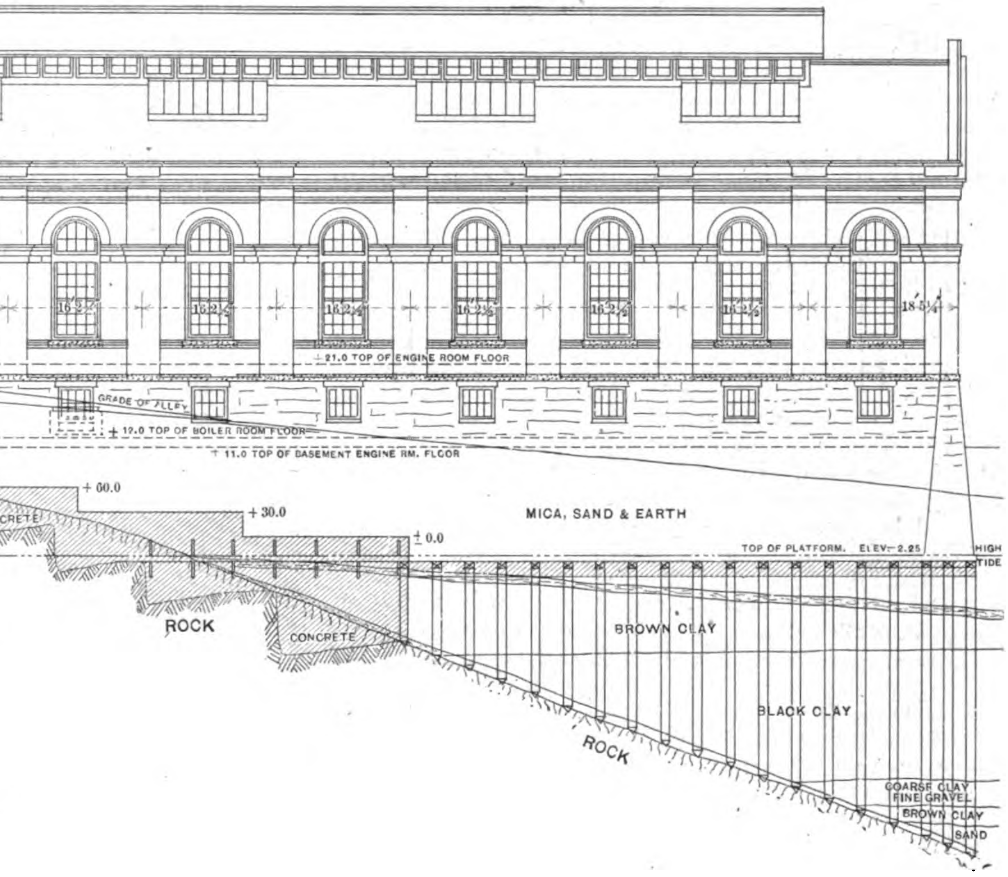


FIG. 4.—LONGITUDINAL SECTION OF POWER STATION, SHOWING FOUNDATIONS.

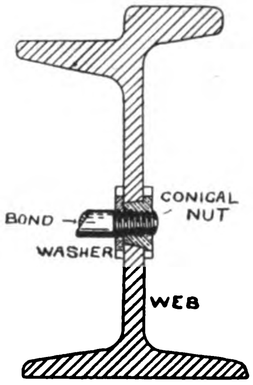


FIG. 7.

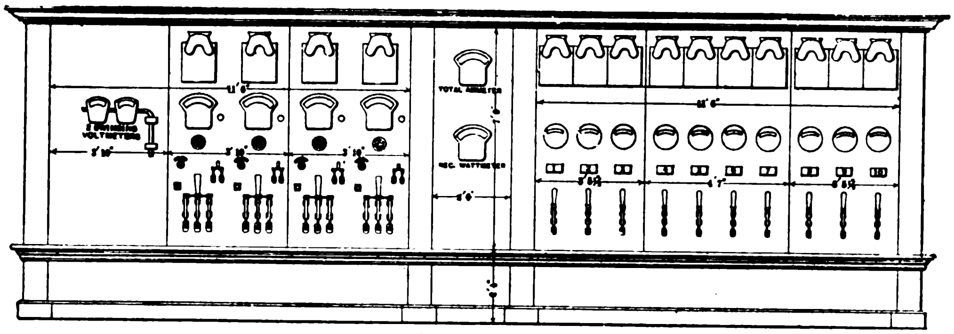


FIG. 5.—SWITCHBOARD.

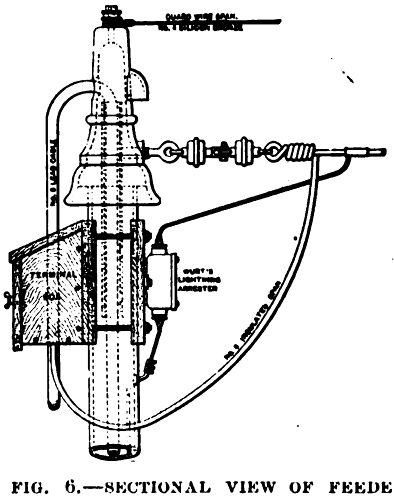


FIG. 6.—SECTIONAL VIEW OF FEEDER POLE AND TERMINAL BOX.

FIGS. 2, 3, 4, 5, 6 AND 7.—AN IMPORTANT ELECTRIC RAILWAY POWER STATION.

boiler. An indicator gives firemen notice when coal in bin falls below a certain level. A track runs in front of the boilers over which cars carrying coal or ashes may be run.

Engines and generators: The engines, four in number, are 500-horse power tandem compound condensing Greene, built by the Providence Steam Engine Co., and have handled the loads economically, and without any trouble since the plant was started. They are direct coupled to general electric 400-kilowatt multipolar generators, running at 100 revolutions per minute. The Greene engines, as built by the above company, have stood the test of years of service among slow speed, heavy duty engines, and a more detailed description may not be out of place for those engaged in electrical plants.

In this engine the steam valves are connected to the cut-off mechanism by a set of rods or stems running parallel to their seats and emerging through stuffing boxes. These stems are connected to the rock shafts. The exhaust valves are gridiron slides, set to travel across the line of the cylinders, and are driven by a horizontal rock-shaft, extending forward to the eccentric on the crank shaft. The trip or cut-off motion for the steam valves is shown in Fig. 8. The tappets EE′ are carried by the rock shafts BB′, which in turn drives the arms CC′ and the valves attached to the stems DD′, passing into the steam chest.

The tappets AA′, which are carried by the sliding bar F, engage these rock levers. The movement of the tapplets up or down is governed by the gauge plate G. This gauge plate is connected to the governor by a bell crank lever and rod R. If from any cause the speed of the engine should rise above that for which the governor was set, the governor acting through the rod, bell crank and gauge plate would depress the tappets, causing them to shorten their hold with the rock lever and thus allowing the steam to be cut off earlier. Should the speed fall below that for which the governor is set, tappets AA′ are raised and will remain in contact a longer time and cutting off later in the stroke.

Referring to Fig. 8, the dotted line Z shows an arc of a circle or the swing of the end of tappet E; the tappet A′ is about to let go of the tappet E, and the height of A′ indicated by the line 1. If the load should increase or speed fall and the tappet A′ rise to the line marked 2, the tappet E would be carried to the point on the arc Z where the line 2 and 2′ come to a point, showing how the valve opens wider, and cuts off later in the stroke. Now by this operation the valve closes very quickly, thus allowing the steam to expand in the cylinder, doing work very economically.

These engines are capable of cutting off steam anywhere between the beginning and three-quarter stroke. The valve seats on the exhaust side are easily removable from the outside, having outside connections. They can also be adjusted without interfering with steam valve. There is an automatic stop connected with the governor. Should belt break or slip from pulley the governor balls operate a knock off which allows the tappets on slide bar F to fail to clear the rock arms, thus shutting of steam. No load is thrown on the governor, and to overcome any oscillation a dash pot is used. The stuffing boxes are easily accessible, and the connections between the two cylinders are strongly made. As should be the case in all engines designed for railway work, very liberal calculations were made for all parts of these engines, so that they are able to stand heavy overloads without detriment.

The generators have highly efficient field frames of steel, armature windings of hard drawn copper bars, commutators built in removable sections, ventilated core, and laminations, individually held to hub by dove-tailed key, which mean easy repair and small cost of maintenance. These are all important features. The shaft carrying the armatures is 18 inches in diameter. The generators regulate closely, and there is no sparking at the brushes.

The switchboard, designed by the chief engineer, is thirty feet in length marble face, and contains all the instruments for regulating and measuring the current. The feeder panels of the general electric pattern are at the right. All connecting cables from generator pass under the floor to the switchboard and from there to the testing room. A complete set of instruments are provided here for testing the insulation, capacity and resistance. The switchboard is situated directly in front of the generators, and can be plainly seen by an attendant at any machine. The station is provided with damper regulator, speed and regulator recorders and indicators.

The road is running about 100 cars, and the load morning, noon and night is very heavy. The plant handles the load without any difficulty. The rails are bonded by a bond invented by Mr. Johnston. The cut, Fig. 7, shows the details of the connection. It affords a large area of contact, about twelve times the bond area; the end of the bond is threaded; a washer screws on, forming a shoulder bearing against one side of the web of the rail; the hole having been reamed, on the end of the bond is screwed a conical nut just fitting the reamed hole and with a flange which bears against the web. The surfaces are brightly polished before bond is put on, and when the nut is screwed up the flanges bear tightly against both sides of the web. It requires no skilled labor to put on the bond, and the loss through resistance of return circuit is reduced 30 to 40 per cent. The bonds were made by John A. Roebling Sons, of Trenton, N. J.

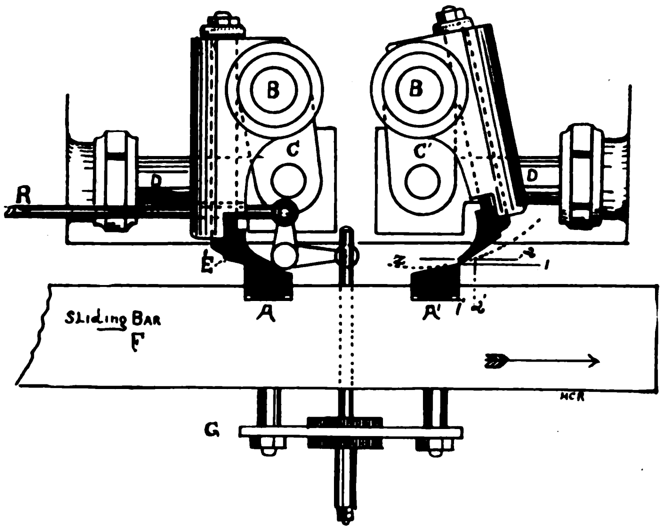


FIG. 8.—DETAILS OF VALVE GEAR.

In making an inspection of this power house the cleanliness of the engine room is the first noted. Everything is light, and the metal work is kept brightly polished. The power house is under the supervision of Mr. J. D. Lynch, the power-house superintendent.

This power house is a model, and a credit both to the company and its designers, Mr. Johnston and his assistants, Mr. D. A. Hegarty, at that time first, and Mr. H. A. Clark, second assistant, engineers.

Electric Power for the Smaller Manufacturing Plants.

There was recently erected in Pittsburgh a building designed for the accommodation of a large number of small manufacturers. The building has a central power plant provided with electric generators for the transmission of power to the tenants. The building has thus no belts, shafting, etc., and is not only less encumbered but there is also less noise and rattle. Space is saved and the charge to each tenant is in proportion to the amount of power used. The system is said to be most economical for all. The power, although used in small quantities, is obtained at a rate per horse-power but a trifle more than the cost to large consumers having their own plants.

The announcement is made that after November 1st the American Engineer and Railroad Journal will be issued each alternate Thursday instead of once a month as formerly. It is hoped by the managers that the publication will be enabled to keep more closely in touch with current events by a more frequent issue. This journal is one of the oldest engineering periodicals published in the United States. It was started as the American Railroad Journal in 1832 and has gradually grown to its present size and merit.

The Electric Rheostat and its Construction.

BY E. D.

The primary idea of a rheostat is a device for controlling the electric current, for diminishing and increasing its flow and thus the work which it does. The office of the rheostat as used to start up an electric motor is similar to that of a steam valve on a steam engine; that is, it is simply used to give a gradual admittance of the current to the motor, and is usually cut entirely out of circuit as soon as motor reaches maximum speed.

The necessity of the rheostat can be explained by carrying the analogy of the steam valve a little farther. The construction of the motor is such that when it is at rest the full admittance of the current would destroy it, just as the free admittance of the steam to the steam engine cylinder would be almost sure to strain or break some of its parts. The simple reason in both cases is that the inertia of the moving parts of a machine must be overcome gradually.

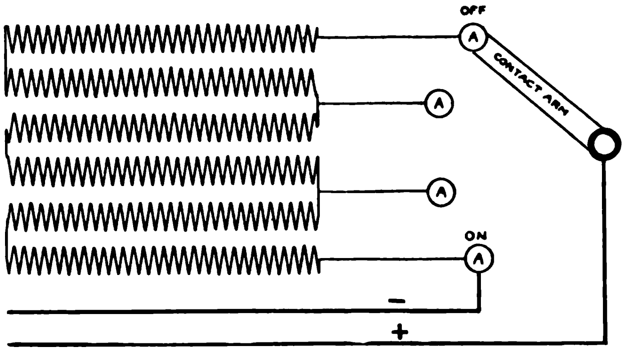


FIG. 1.

Another office of the rheostat is to regulate the amount of current in the magnetic or field circuit of a dynamo or generator. Still another use of the rheostat is for dimming incandescent lamps, that is, reducing the amount of current flowing to the lamps. These are used largely in theaters and similar places where it is desirable to vary the intensity of the illumination. The plan upon which all rheostats are constructed is such an arrangement of electrical conductors of greater or less resistance that they may be readily thrown into the electrical circuit. In the selection of the resisting conductor, its mounting, method of connecting in circuit and the mechanical details the rheostats of different makers differ, yet the principle underlying their construction is the same.

The resistance conductors of the rheostat not only restrict the flow of the electric current but consume when left in circuit a considerable amount of electrical energy. This energy is transformed into heat which is always noticeable about resistance conductors when a current is passing through them. It is this fact that is made use of in the electric heater, the electric car heater, electric cooking utensils, etc. Since the resistance of most of the metals varies with the changes of temperature it is good practice to so design the rheostat that it will present a large radiating surface or allow the air to pass freely through the coils.

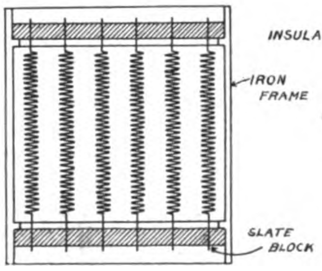


FIG. 2.

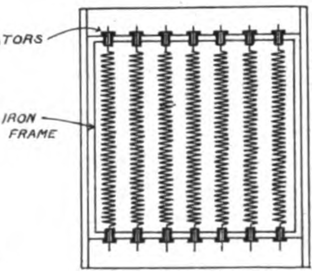


FIG. 3.

When the rheostat is used to regulate the amount of current passing through the field circuit of a dynamo, or is used as a dimmer the current carrying capacity of the rheostat should be such that it can be left in circuit with the regulating arm in any position without causing injury by overheating.

In the case of a motor starter the resistance may be so designed as to allow a flow of the maximum starting current for less than one minute. This current in shunt motors often rises to slightly more than double their full load running current. For combination motor starters and controllers, both the full load current and the maximum starting current must be allowed for, that is, the resistance must be so formed as to allow the controlling arm of the rheostat to be left in any position for at least one minute without causing any injury to the apparatus.

In designing automatic motor starters it is good practice to so apportion the resistance as to allow the full load current to be admitted to the motor at the first contact point and a capacity of the maximum current at any point for about one minute. Several materials have been used as resistance, the principal ones being German silver, iron or steel, carbon and liquids.

The metals, German silver and iron, in the form of coils of wire have been largely used, though some builders use sheet metal and build up the resistance in layers insulated by mica and asbestos, the layers being connected by copper strips to which leading or terminal wires are joined at certain intervals. Other makers use very thin wires imbedded in porcelain or similar substances. This form requires only a very small space for a given resistance and current carrying capacity.

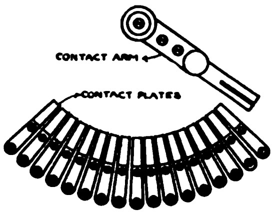


FIG. 4.

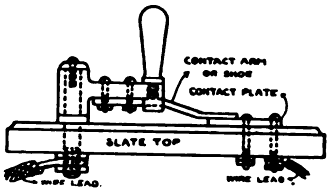


FIG. 5.

A rheostat consists principally of the following parts; the resistance, which we may consider as being made up of coils of wire connected in series, the contact points or plates which are connected at uniform intervals to the series of coils (Fig. 1. A. A. A. are contact plates,) the contact arm or shoe which is made to move along over the contact plates, and the terminal or binding posts one connected permanently to one end of the series of coils, the other to the contact arm or shoe. The amount of resistance in circuit is then increased by moving the lever toward the point marked "off" and decreased by moving it toward the point marked "on." The rheostats in use at the present time are required to be fireproof.

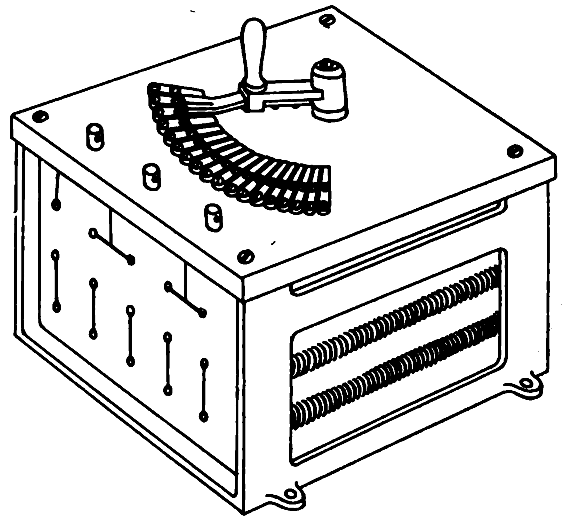


FIG. 6.

The frame is usually of iron and the coils are stretched between blocks of slate, Fig. 2, or holes are drilled in the iron to take porcelain or other insulating bushings, Fig. 3 through which the wires are passed. The ends of the wires are connected in the desired manner by metal plates, resting on the bushings, or are twisted together if the wire is thin. The contact plates are usually placed on a block of slate, Fig. 4 and 5, in the are of a circle, in the center of which the contact arm or lever is pivoted. The number of contact plates to be used in any given case depends on the amount of resistance and the quantity of current to be controlled. The number of plates should be such as to allow the changing of resistance at a slow rate with almost no sparking. The plates can be quite narrow, and the contact shoe wide enough to cover two plates at a time. A good number of plates to use on hand starting boxes for motors of ordinary voltage is 10 or 12. For automatic rheostats where the movement of the contact arm is quite rapid and it is desirous to have as little chance for sparking as possible, it is good practice to put on double the above number of plates, or even more than that for 500 volts or higher voltages. On hand-starting boxes it is customary to have one contact plate that is not connected to the resistance so that when the contact arm is at the position marked "off," Fig. 1, the circuit through the resistance is entirely broken. In Fig. 6 a general sketch of a simple hand starting-box is given.

American Street Railway Association, Fourteenth Annual Meeting.

The annual convention of the American Street Railway Association is to be held at Windsor Hall, Montreal, commencing Tuesday, October 15, and continuing four days. The program of the meeting has been arranged with reference to the special needs of the association and so as to bring out as much information as possible on each of the subjects before the convention. Committees will report on the following subjects: "Transfers"; "Municipal Ordinances"; "Labor Question -- Wages Paid to Employes"; "Experience of Roads in Furnishing Music and Other Entertainments to the Public;" and "Physical Operations of Roads."

The annual dinner will take place on Thursday evening, October 17. Each company that is a member is entitled to the free admission to the banquet of two of its officers. Each additional officer, or any other gentleman in attendance at the meeting not an officer of a member-company, will be charged ten dollars; ladies' tickets, five dollars each.

There will be ample hotel accommodations for all who attend the meeting. The headquarters of the association will be at the Windsor Hotel. The rates at the hotels are as follows: Windsor, $3.50 to $5.00 per day; St. Lawrence Hall, $2.50 to $4.00 per day; Queen's, $2.00 to $3.50 per day; Balmoral, $2.00 to $3.50 per day; Cadillac, $1.50 to $2.00.

All hotels are on the American plan, and rates according to location of rooms. Rooms will be assigned in the order of applications received, and as far as possible in accordance with the expressed wishes of the applicants. Those who expect to be present should communicate at once with the proprietors of the various hotels named. All the hotels named are within easy distance of the Windsor Hall, where the meetings of the association witl be held, and also convenient to the Victoria Rink, where the exhibits will be on view.

Exposition of Street-Railway Supplies.—The executive committee has secured Victoria Rink, Montreal, Canada, for the exhibition of supplies of every nature used in the street-railway business. The building has been engaged for two entire weeks, beginning October 9, and ending October 22, thereby giving ample time for the setting up and removal of the largest exhibits. The hall for the meeting is adjacent to the exhibition building, and delegates will therefore be enabled to examine the exhibits to the best advantage, and with the least possible loss of time. The exposition will be in charge of Mr. Stonewall Jackson, 27 St. Sacrament street, Montreal.

Reduced Rates of Fare. The traffic associations have authorized the sale of tickets at reduced rates -namely, a fare and one-third for the round trip. This concession applies to all attending the meeting - delegates, supply dealers and accompanying friends. The traffic associations that have extended this courtesy are the Trunk Line Association, the Canadian Pacific Company, the Central Traffic Association, and the Boston Passenger Association.

Western delegates will find the train made up at Chicago on the Lake Shore & Michigan Southern, passing through Toledo, Cleveland, Ashtabula, Erie, Dunkirk, Buffalo, Rochester and Syracuse, will possess every comfort and convenience. As the convention has been set to open a day earlier than usual, commencing Tuesday morning, October 15, it will be necessary to leave Chicago Sunday morning at 10:30 o'clock, arriving at Toledo at 4:45 p.m.; Cleveland, 7:35; Ashtabula, 8:54; Erie, 9:54; Dunkirk, 10:01; Buffalo, 12:10; Rochester, 3 a.m., and Syracuse 5 a.m. Cars will run through to Montreal without change. Delegates desiring to leave any other date should take either the 3 p.m. train, or the limited 5:30 p.m., arriving at Montreal at 10:15 p.m. the following evening. The special rate for the round trip is $24 on the certificate plan, and the sleeper $5 each way.

For eastern delegates arrangements have been made for special train via New York Central & Hudson River Railroad Company for the accommodation of delegates and others attending the Montreal convention of the American Street Railway Association. The special train will leave the Grand Central station, Forty-second street, New York, Monday, October 14, at 6 p.m., arriving in Montreal Tuesday morning, October 15, in time for breakfast. A dining car will be attached to the train leaving New York. The rate for the round trip from New York City to Montreal and return, of $13.35 has been granted. Wagner sleeping car accommodations will be provided at the usual rate of $2 per berth from New York City to Montreal. Tickets should in all cases be purchased on the certificate plan, procuring with the ticket a delegate's certificate, which, when properly countersigned at Montreal, entitles the holder to a return ticket at one-third the regular fare.

A Boiler and Engine Test.

The following data is taken from the records of the Grosvernor-Dale Co., of North Grosvernor-Dale, Conn.

Result of test of high pressure boilers.

Nos. 1, 2 and 3 Boilers.	Run 60 hours.
Pounds of coal used for banking and starting fires	15540 pounds.
Four days' run, 60 hours	48191 "
Total pounds of coal	63731 "
Pounds per hour	10622
Horse-power average per hour	736.4
Pounds of coal per indicated horse-power	1.44

The above is a commercial result of a week's run subject to all the "outs" of everyday practice.

No special preparations were made. The week is like every other week in the year.

The boilers are plain, horizontal tubular, without economizers, fancy settings, or any special device whatever.

The coal was Georgia Creek and fired by hand, by ordinary, everyday firemen.

A steam feed pump was run from these boilers and small amounts of steam taken for other purposes.

Coal used on Wheelock engine with Hill valve gear; feed pump run from low pressure boilers. Steam for Nos. 1, 2 and 3 boilers used for engine only. As per test for three weeks' engine September 7, 1895.

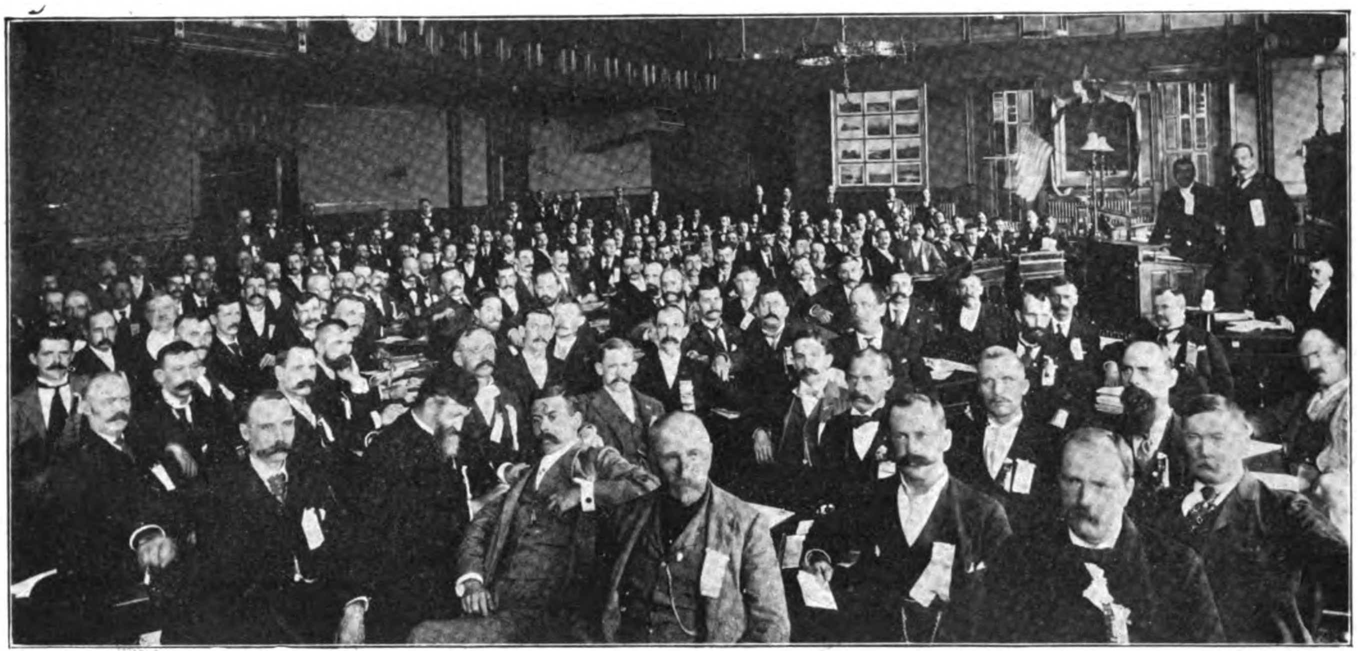
Pounds of coal used	185188
Indicated horse power	14019.5
Pounds of coal per horse-power	1.321
Pounds of coal per day	10288.3
Horse-power per day	778.85

The above results were taken from the regular running records of the plant, the only unusual feature being extra care in weighing coal and power. The latter is very careful indicated through the day, and from long experience is known to be accurate. Engine is built under the Rockwood compound system.

The Annual Convention of the National Association of Stationary Engineers.

The fourteenth annual convention of the National Association of Stationary Engineers held at St. Paul on September 3, 4, 5 and 6, was a well-attended and most successful meeting. The delegates and guests made their headquarters at the Hotel Ryan, from which place they were escorted in a body by the local committees to the hall of representatives at the State House, where the sessions were held. An address of welcome from Governor Clough extending the freedom of the state and address by Mayor Ehrmanntraut extending the freedom of the city assured the delegates that they were in friendly hands. Mr. James G. Breckerley, of Chicago, responded to the address of welcome and accepted on behalf of the association the courtesies extended. Mr. M. D. Nagle, of New York, president of the association, after a few remarks, called the convention to order and to the business of its 14th annual session. The president's address was attentively listened to, and afterwards ordered printed.

The afternoon session of the first day was largely taken up with reports of committee and other matters of business. The life and accident branch met in the evening for the transaction of business and the appointment of committees for the ensuing year. Reports showed remarkably low premiums for the past seven years, indicating a very successful period. Mr. Harry Knowlton was elected secretary and treasurer, and William Manson, of St. Louis, and John Trix, of Detroit, were elected trustees.



From Photograph taken by Power.

ANNUAL CONVENTION OF N. A. S. E.—DELEGATES IN SESSION.

The first business of the second day's session was the appointment of the committees by the president; the list is as follows: License Laws—Donovan, Massachusetts; Thies, New York; Pascos, Michigan; Oleson, New York: Foster, Nebraska; Sheridan, Ohio; Hawkins, Pennsylvania; Schuneman, Wisconsin; Vaux, Pennsylvania; Kelly, Illinois; Grosvenor, Indiana.

Ways and Means—Pearson, Kansas; Dare, New York; Tucker, New Jersey; Delaney, Ohio; Steele, Minnesota; Matthews, New Hampshire; Reiley, Nebraska; Boyle, Pennsylvania; Carr, Rhode Island; Earley, Wisconsin.

Appeals and Grievances—Noble, Illinois; White, Connecticut; Moore, Minnesota; Regan, New York; Bolton, District of Columbia; Richardson, Illinois; Rose, Indiana; Foster, Kentucky; Bell, Mississippi; Nunnally, Maryland; Donovan, Massachusetts.

Mileage — Stone, Massachusetts; Brien, Connecticut; Avis, Colorado; Boozer, Illinois; Turnpaugh, Texas; Beebe, Iowa; Pierce, Louisiana; Reid, Massachusetts; Daney, Michigan; Tinsley, New York. The meeting soon afterwards was adjourned to allow the committees to go into separate sessions.

The business of the third day was transacted promptly, and after its adjournment the delegates accepted invitations for various pleasure excursions. The committee on ritual reported in favor of abolishing all secret forms in the association with the exception of the password and the installation exercises. The report was adopted. The committee on ways and means reported on a number of the resolutions referred to them. The report favored the resolution to appropriate $150 for a propagation fund, but reported adversely on the resolution to reduce the per capita tax. The resolution for the appointment of a committee to request congress to pass laws favoring the engineers was returned without recommendation.

The report of the mileage committee caused considerable discussion. The report showed there were 163 delegates entitled to mileage, and that the total amounted to $3,540.99. The secretary announced that this was $185 more than there was in the treasury. A motion was made to borrow enough from the contingent fund to make up the balance, but it was ruled out of order by the chair. On an appeal the chair was overruled and the motion was carried.

The principal business before the association on the fourth day was the new constitution and the election of officers. The constitution was taken up section by section, and each was adopted or rejected. But few changes were made, however, in the work of the committee. The election of officers resulted as follows: President, Charles H. Garlick, of Pittsburg; vice-president, John W. Lane, Jr., of Providence; secretary, James T. Edwards, of Chicago; treasurer, Daniel Delaney, of Cincinnati; conductor, G. S. Dill, of Goshen, Ind., and doorkeeper, E. Pearson, of Atchison, Kan.

Buffalo will probably be selected as the city for the fifteenth annual convention. The cordial invitation and effective speech of Mr. Chambers probably turned the scale in that direction. Before adjournment the association passed a vote of thanks to the "twin cities" for the way in which they had treated the convention. There were present many representatives of manufacturers and dealers in engineering supplies, who had their headquarters at the Ryan. Many new and improved appliances were displayed.

The social features of the convention were greatly appreciated. The local committees had provided an interesting program, including a musical and a reception to delegates and wives at the Ryan, a reception at the Commercial club and excursions to points of interest.

"We consider Electrical Industries the best electrical paper that comes to our table."—W. B. Sanford, Supt. Pipestone, (Minn.,) Elec. Lt. Co.

"I enjoy your puplication very much."—Henry B. Colmes, Sec. and Treas., Springfield, (Vt.,) Elec. Co.

LESSONS IN PRACTICAL ELECTRICITY

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

Easy Lessons in Chemistry.

BY D. D.

It is proposed in this lesson to give a few of the elementary principles of chemistry that will be helpful in the study of electricity. We will not study it for itself, but as an aid in our regular line of study. Many of the processes in the generation of electricity are only understood when we possess a slight knowledge of chemistry.

Chemistry is the science that deals with the composition of matter in the many forms in which it is found. Under the name matter is included all solids, liquids and gases, in fact, everything that exists. The same body we may find now as a liquid at another time a solid or perhaps at another time a gas. It has the same composition in each case but has only changed its form. The water in our smaller lakes and streams becomes solid in severe winter weather or at the refrigerating plant in the ice pans and the ammonia gas in the pipes of the refrigerating plant is under pressure forced into a liquid form yet the water has the same composition as the ice and the liquid ammonia has the same composition as the ammonia gas.

If we take a piece of rock and break it into small pieces with a hammer, we have still matter of the same composition, only in smaller pieces. If we place these pieces in a mortar and grind them into the finest powder we have not changed the composition but by mechanical means we changed our piece of rock into fine powder. The smallest possible division into which we can divide a mass without changing its composition is called a molecule. So if we could continue the grinding of the pieces of rock long enough we would have it separated into molecules. We shall have overcome the force that held the molecules together and completely separated them.

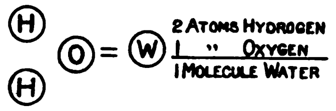
The molecules are attracted together in different degrees. The molecules of some substances repel each other and so forcibly do they drive each other away that but a very small number will occupy a given space. Therefore it is very light and rises into the air. The molecules of other bodies have but a very slight attraction for each other, and we call such bodies liquids. Other molecules are strongly attracted and we call them solids. Sometimes by applying pressure the molecules will be forced near enough together so that they will be held by the attraction of the particles together in a solid, or the gas will be held in a liquid.

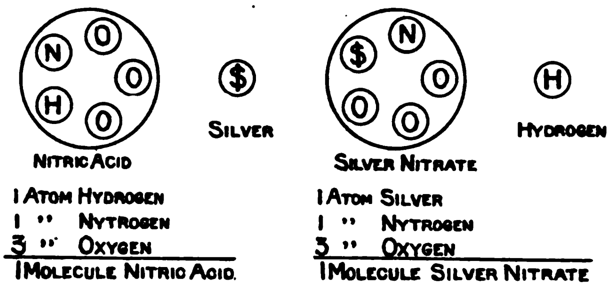
By chemical means we are able to break up these molecules but when it is done we find we have something else besides rock dust. Suppose the rock was an iron ore and we turn it over to the chemist. He tells us it is the red peroxide of iron ore. He takes it into his laboratory and after some time brings us out a small dish containing a heavy solid which he tells us is iron and in a glass jar he tells us he has a gas called oxygen. It is perfectly transparent; we can see nothing. He brings out another glass receiver and opens the one into the other. There is a pop like the discharge of a gun and water is observed to run down the sides of the jar, so we must accept his word, as there was no water in the jar and no pistol to make a noise before he opened the two together. By some means he has taken our powdered rock and changed it into two distinct substances which have no resemblance to it.

The final substances into which a body is divided, are called the elements. Thus we have the metals, gold, silver, copper, etc., the gasses and liquids, that will unite to form various compositions but cannot be separated into two or more distinct substances themselves. As was just stated a molecule is the smallest particle of matter into which a body can be divided without changing its identity. The atoms are still smaller particles into which a molecule may be divided. It is the smallest division of an element. A molecule is too small to be seen with the most powerful microscope and an atom is several times smaller. In our division into molecules we applied only mechanical means to break them up but in separating the atoms chemical methods are necessarily employed.

Few elements are found in a pure state in nature but are generally found united with other elements, like the iron in the iron ore. Sometimes the combination is only mechanical, other times it is a union of atoms—chemical. The air is but a mechanical mixture of oxygen and nitrogen, the molecules of oxygen being mixed with the molecules of the other gas. Water is a chemical combination and affords an illustration of two gases uniting and forming a liquid. The molecules of the elements are not always composed of the same number of atoms. In the air the molecules of oxygen are usually composed of two atoms of oxygen but sometimes of three. When composed of three atoms it is called ozone which is noticeable after severe thunder storms and is produced artificially by passing electric discharges through the air.

The atoms of an element are held together in the molecule by a force, an attraction. We do not know what it is any more than we know what the force of gravity is, yet we know its laws. The atoms of different elements have a greater or less attraction for each other. Thus, if atoms of oxygen and hydrogen are brought together they unite in molecules always in the same way. Two atoms of hydrogen uniting with one atom of oxygen form one molecule of water.





We cannot see the joining of these atoms, therefore it is harder for us to understand how it takes place. All elements are not equally attracted toward each other. Therefore those of the elements that are placed together having the greatest attraction will unite and leave the others separated, united in several groups or all united in a single combination. If we place a drop of acid in a glass of water the acid will be distributed through the water, the molecules of acid uniting with the molecules of water until it is diffused through the entire contents of the glass. If we take a glass of nitric acid and drop into it a silver dime, the dime will gradually disappear, being "eaten up" you might say, by the acid. Let us study what takes place. Nitrogen, one atom, hydrogen, one atom, and oxygen, three atoms, form one molecule of nitric acid. The atoms of silver are picked up by the molecules of acid which throws away its atom of hydrogen. The hydrogen being lighter than water or the acid rises to the surface and out into the air. So we have left in our glass what remains of our water and acid and another composition, which is called silver nitrate, its molecules being composed of one atom of silver, one atom of nitrogen and three atoms of oxygen.

During the recent yacht race cablegrams were sent from the course direct to Europe. For this occasion the Commercial Cable Co. laid a special length of cable from the shore end of the transatlantic cable to the course where the yacht race took place. A cable steamer laid the cable and anchored at a most convenient point for witnessing the race. The operators on board were thus connected with Europe and the news was received there almost as quickly as in New York.

Trimming Arc Lamps.

BY A PENSIONER.

It was a difficult matter with the first arc lamps and first carbons to keep the lamps properly trimmed. I can remember when we made several trips along the circuit each night to see that the lamps were burning, once when the machines were started and again a few hours later to see that they were burning all right. The carbons we used then were not always very straight, so they sometimes slipped passed each other even with the most careful trimming. Another source of trouble was that the carbons, not being uniform in quality, would sometimes split up in such a way that the carbons would be thrown out of line, or a point would be left, which would shade that part of the arc, or the carbons would "sputter" and "siss," giving little light. We also frequently had trouble with the working of the regulating mechanism, but that had nothing to do with the trimming. As manufacturers have improved the quality of the carbons the trimmer's duties have became less arduous. When the lamp is trimmed during the day it is expected to and usually does burn steadily until the plant is shut down.

All persons will not make good trimmers, any more than they will make good presidents or good physicians. The first quality is a good eye. The trimmer should also be neat and careful about his work, know how to climb and be able to make temporary repairs, if it is necessary. The trimmer passes over the lines every day, and should therefore combine with his other duties that of an inspector. Any disarrangement of the lines, broken arms, insulators or interference should be noted, as he makes his round and reported to the repair department.

In trimming a lamp the upper carbon rod should first be cleaned so that the friction will be reduced to a minimum. This is one of the most important points since the least interference with the movement of the carbon rod seriously interrupts the close regulation of the arc. It is best to put the lower carbon in first. When the upper carbon is inserted by turning the rod around, if it is raised by a clutch, it can easily be detected whether the carbon is perpendicular. If it is not straight the lower end of the carbon will move in a circle instead of remaining in a straight line. Where both carbons are inserted, a sufficient length of rod should project below the case to allow the carbons to be drawn apart when the lamp is started. All parts of the lamp should be freed from dust before leaving it.

It is advisable to remove the casing of the lamp now and then and clean the working parts of the lamp. For no matter how well constructed the case may be, dust will find its way in. When a lamp is once properly adjusted it should not be changed too hastily. Lamps often burn unsteadily when the adjustment is correct from poor carbons or other causes. Therefore, before readusting, the lamp should be watched and examined carefully to see that other causes do not affect its operation.

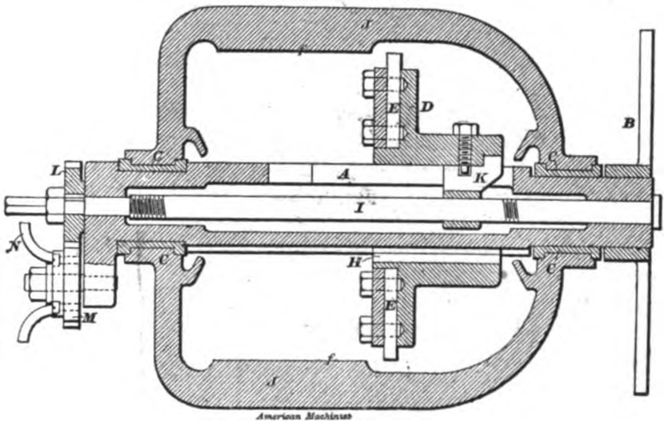
Brick-dust Mortar.

The use of brick-dust mortar as a substitute for hydraulic cement, where the latter cannot be obtained, is now recommended on the best engineering authority; experiments made with mixtures of brick dust and quicklime showing that blocks of ½ in. in thickness, after immersion in water for four months, bore without crushing, crumbling, or splitting, a pressure of 1,500 lbs. per square inch. It is considered, too, that the addition of even as small a proportion as one-tenth as much brick-dust as sand to ordinary mortar is preventive of the disintegration so often characterizing mortars used in the masonry of public works. The use of brick-dust mixed with lime and sand is said to be generally and successfully practiced in the Spanish dominions, and is stated to be in all respects superior to the best Rosendale hydraulic cement in the construction of culverts, drains, tanks, or cisterns; and even roofs, whether for setting flat tiles or for making the usual tropical flat roof. The proportions used there in the manufacture are, approximately, one of brick-dust, one of lime, and two of sand, mixed together dry and tempered with water in the usual way.—Southern Architect.

Boring a Motor Frame.

In recent years the price of electrical machinery has been greatly reduced; an important factor of success to the manufacturer is to reduce the cost of production. The following is a description of a boring bar, designed for boring the pole pieces of an iron-clad street-car motor frame. It proved to be cheap of construction and manipulation and quite efficient. The frame *J* was much like a cocoanut, cast in two halves, with bearings for a shaft to run through its greatest diameter, and large spots to be finished inside at *f*. The principal tooling was the boring of seats for heavy bronze boxes and the pole pieces, after fitting and bolting the two halves together. The box seats were first bored to gage in a horizontal boring machine at one setting.

Temporary boxes *C* were fitted into these seats, with an internal diameter to fit the boring bar; these boxes were put on in halves, and one situated between fixed shoulders received all the thrust. The bar proper, *A*, was a hollow cylindrical steel casting. The ends were reduced in diameter for journals. A cored slot ran nearly the entire distance between the journals. Outside the journal, on one end, was pinned a driver *B*—simply a hub with two arms—to be driven by two bolts fastened to a face plate. Outside the other journal was cast a short arm, which carried a gear *M* by a stud. On the side of the gear was attached a star *N*, the points of which were offset from the side of the gear. The points of the star hit against a stationary stop when the bar was in operation. In mesh with this gear was a gear *L* keyed to the feed screw *I*, which ran concentric through the bar. The gear end of the screw was squared to receive a crank handle to turn the screw back. The ends of the bar were bored to form bearings for the feed screw. On the feed screw ran a bronze nut *K*, with an arm or lug on the side projecting through the slot in the bar. The nut drove the cutter head by contact with its hub. A hole in the arm of the nut engaged loosely a stud in the cutter head hub to bring the cutter head back to the beginning of the feed. The cutter head *D* was shaped like a face plate; the hub fitted the outer diameter of the bar, which contained a keyway. In this keyway ran a feather *H* dovetailed to the hub of the cutter head. In the face of the cutter head were cut four or five radial grooves to fit square tool steel.



BORING A MOTOR FRAME.

The cutters *E* were firmly held by straps and screws in the manner of planer tools. The bar was operated by simply dropping it into its place between the upper and lower halves of the frame casting, then bolting the halves together and strapping the whole on the carriage of a lathe. After properly setting the cutters there was no aligning or adjusting to do. It seems evident any other casting with desired boring between two bearings may be so finished.—J. Landsing in American Machinist.

Sacramento celebrated the starting of the Folsom-Sacramento electric power transmission system on Sept. 9. This system transmits power derived from the American river at Folsom to Sacramento, 23½ miles distant. The power plant and system was described in a recent number of ELECTRICAL INDUSTRIES. This plant is one of the first of its kind completed, and marks a most important era in the production of cheaper power.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion.]

The Hornsby-Akroyd Oil Engine.

In the accompanying illustration is shown a view of the Hornsby-Akroyd oil engine which has lately been placed on the American market by the De La Vergne Refrigerating Mch. Co., E. 138th St., New York. The engine has been in successful use abroad, and therefore its working qualities have been fully established. One of the important features of every engine of this type is the ignition, automatically, of the explosive gas in the cylinder. This has been accomplished by chiefly two methods, each of which has its advocates, although other methods were formerly employed, first by tube ignition, and second by means of the electric spark. Each has its disadvantages as well as advantages, but neither is used in this engine. The mixture of the gases being effected, the explosion is determined by their compression in the combustion chamber.

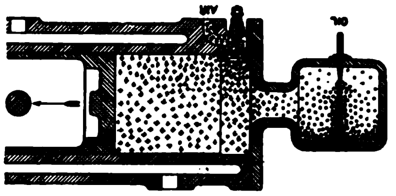


FIG. 1.

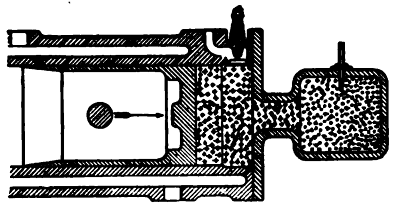


FIG. 2.

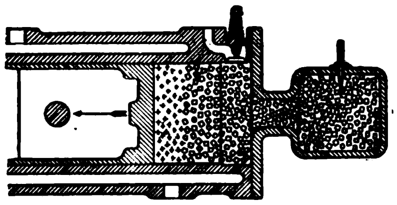


FIG. 3.

FIGS. 1, 2 AND 3.—THE HORNSBY-AKROYD OIL ENGINE.

The real difficulty, however, is in securing this explosion exactly at the moment required. The introduction of valve motion for timing the explosion would naturally suggest itself, but it must be borne in mind that such valves would be subjected to a temperature considerably above red heat. The manner in which this explosion is obtained in the "Hornsby-Akroyd" engine is illustrated in Figs. 1, 2 and 3. In these diagrams the stars indicate air, the circles oil, and the squares products of combustion. The cylinder, it will be seen, is provided with an extension communicating with the cylinder by a narrow neck. This extension is unjacketed and forms a retort in which the oil is vaporized. Nothing but oil in the liquid form is injected into the retort and only air is drawn into the cyclinder. The operation, which is clearly illustrated in the cuts, is as follows:

On the outer stroke of the piston air is drawn into the cyclinder, and oil is injected into the red hot retort. At the end of the stroke we have, therefore, in the retort, oil vapor, which is not explosive, and in the cylinder pure air, which is not explosive, nor is there sufficient leakage from the one to the other to make either of the charges explosive. On the return stroke of the piston the air is forced from the cyclinder through the communicating neck into the retort, and we have the conditions represented in Fig. 1. For a time the mixture of oil vapor and air is too rich for explosion, but as the piston progresses sufficient air is forced in to make the mixture explosive.

The Fig. 2 shows the mixing process, and Fig. 3, by the conventional marking, indicates that the explosion has taken place, and the cylinder and retort are filled with burned gases. This automatic explosion is found to take place exactly as the piston is making the return stroke.

It will be noticed that the ignition takes place within the retort, the piston being protected by a layer of pure air. It is not claimed, of course, that these diagrams are exact representations of what actually takes place within the cylinder; nevertheless their substantial correctness seems to be indicated by the fact that the piston rings do not become clogged with tarry substances as is usually the case with this class of engine. This surplus air should insure complete combustion and, that it is accomplished, is evident from tests made by Prof. Robinson, in which a complete analysis of the gas in the exhaust pipe was made. The exhaust was found to consist mainly of steam, carbonic acid, oxygen and nitrogen, indicating an excess of air.

The oil is sent to the retort by a pump which supplies enough for the full power of the engine. If less power is being used the speed increases a trifle, and a Porter governor opens a by-pass and allows the surplus oil to return to the reservoir. The De La Vergne company has provision for testing each engine, so that it is known that it operates perfectly before it is sent to the purchaser.

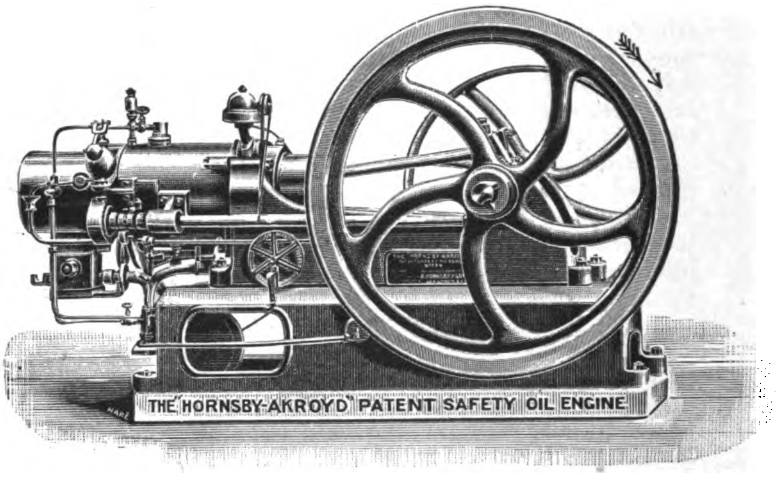

THE HORNSBY-AKROYD PATENT SAFETY OIL ENGINE

FIG. 4.—THE HORNSBY-AKROYD OIL ENGINE.

The "Best" Dynamo and Motor Brush.

Too little attention is generally given to what is one of the most important parts of a generator and motor, the brushes. Poor brushes will prevent the best constructed dynamo giving good results. It is, therefore, necessary in order to secure efficient results to have brushes in every way suited to the peculiar requirements.

The brush, known as the "Best" manufactured by the Elevator Supply and Repair Co., 36 W. Monroe St., Chicago, combines the several qualities necessary for a good brush. It is of low resistance as regards its conducting properties, and also since it quickly adapts its shape to that of the commutator, and always makes good contact, the resistance is reduced to the minimum. It is of woven wire, presenting to the commutator a multitude of contact points, each of which carries a portion of the current. Even if the commutator is slightly worn this flexible brush will give good contacts. It does not become ragged, and requires no trimming, It does not wear the commutator.

The material of which it is made is a phosphor-bronze gauze, tempered in such a manner as to give it great elasticity. This material with the mechanical construction makes it a smooth running, noiseless brush. There is also a new principle involved, and that is that the brush, being of a different metal from that of which the commutator is composed, will give better results, less interference and less friction. Every brush is guaranteed to be perfect. These brushes are being extensively used on both motors and dynamos, and many complimentary letters attest the fact that they meet every requirement of efficiency and durability.

Automatic Safety Limit Switch and Rheostat for Starting Stationary Motors.

The accompanying cuts show improved devices manufactured by the Card Electric Company, of Mansfield, Ohio, for starting stationary motors. Fig. 1 illustrates the new safety, limit switch and rheostat for starting stationary motors, and is not only a perfect safeguard against damage to the motor from open circuits on the line while the motor is running, but is reliable as a limit switch and may be adjusted for any per cent of overload desired.

The principal operating parts consist of two bar electro-magnets in circuit with the line armatures; a double pole switch with spring release; a resistance contact arm held normally at "off" by a flat coil spring and the usual contact points and building blocks.

Aside from the general excellence in design and construction of this starting box, its principal novelty lies in the arrangement of parts constituting the magnetic circuit. The two bar electro-magnets operating the releasing mechanism are provided with pivoted armatures at each end, common to both, the lower one acting as a yoke when closed, forming with the two cores a simple horseshoe magnet; this armature or yoke is, however, so pivoted that should the current for any cause cease to flow through the line while the motor is running, the spring provided for throwing the double pole switch will instantly be released, and tripping in turn to catch, holding the swinging arm that will be thrown "off" over the contact points, cutting the resistance in and placing all parts of the apparatus in proper position for starting again. An overload pulls the upper armature down, releasing the detent holding the switch closed and that, with the swinging arm is instantly thrown to "off" the same as for no current.

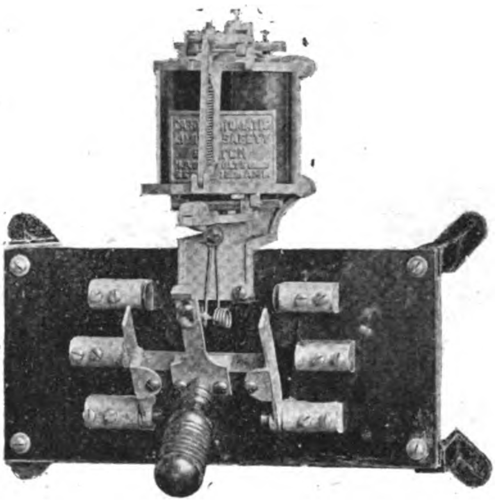


FIG. 1—AUTOMATIC SAFETY LIMIT SWITCH AND RHEOSTAT.

The magnets of this switch differ from other automatic switches in having but one coil of heavy wire, of few turns, carrying the full current of the motor. There are no fine wire coils or differential windings to give trouble and cause unreliable action. The work of releasing the catches is done direct and in the simplest possible manner and is so divided in the mechanism that failure to act is quite impossible. The lower pivoted armature releases the switch for "no current" and the upper armature for "overload." The adjustment of one does not in any way affect the other.

Fig. 2 illustrates the Card automatic safety and limit switch designed to use with motors not provided with a safety switch; thereby saving the user the cost of a new rheostat. This is done by simply changing the connection of wires between the starting box and motor, to the switch, and operates in every way the same as the Card combined switch and rheostat, as illustrated in Fig. 1

When the current for any cause ceases to flow, the switch will automatically open, and also if the motor is overloaded more than is provided for in the adjustment of the spring holding the upper armature off the magnets. Where old style starting boxes are used it is necessary to look after an overload and is usually done by inserting in the circuit near the motor, pieces of fusible metal, supposed to have certain carrying capacity at which they will melt, thereby opening the circuit. The result in most cases is if the fuse is just suited to the motor and a temporary overload happens a few times, blowing it out, the trouble of putting in a new one will tempt the attendant to put in one of twice the carrying capacity necessary, or, as is often the case, a piece of wire or other metal, so that the motor has no protection at all. Again, fuse metals are never reliable since it is hard to get two pieces that will melt at the same temperature, and if they do, the time taken to fuse them may, with a heavy current, affect the armature seriously. By using the Card switch there is no danger whatever of injury to the armature, because of overloads, since it can be depended upon to act every time and act promptly.

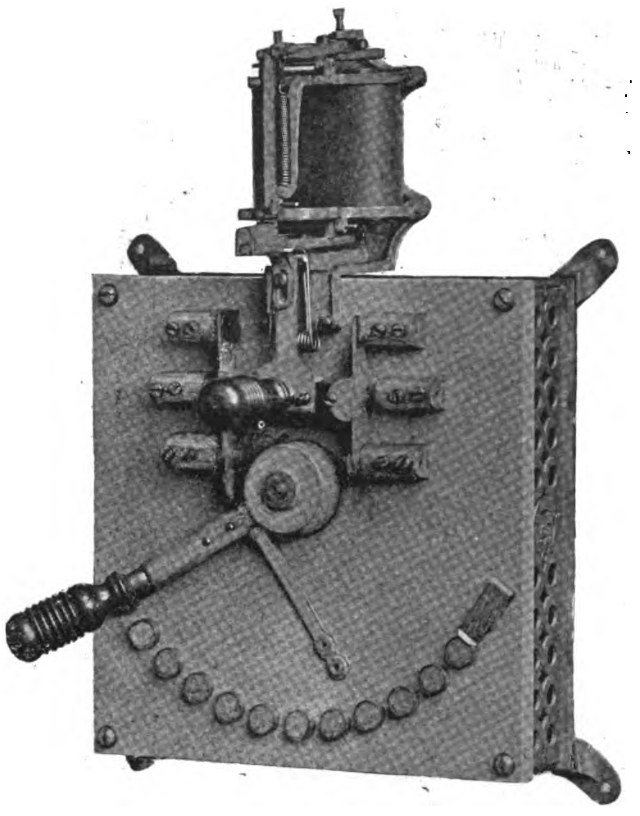


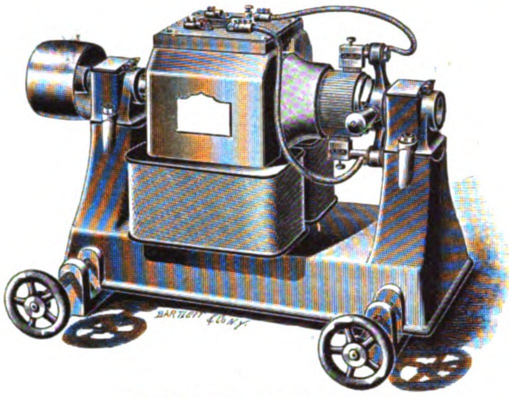
FIG. 2.—AUTOMATIC SAFETY LIMIT SWITCH AND RHEOSTAT.

The Card automatic starting boxes will perform the following duties: First.—They will prevent excessive overload on the motor at starting, caused by cutting out the resistance too fast. Second.—They will open the motor circuit and cut in the resistance instantly, if the generator stops or the line is opened. Third.—They will open the circuit and cut in the resistance if a load is put on the motor in excess of the limit for which the regulating spring is set for. Fourth.—They will open the circuit and cut in the resistance if the belt breaks or is thrown off. Fifth.—They will prevent the starting of the motor in any but a safe and proper manner, and will take care of it while running, better than any attendant can, and acts much quicker. Sixth.—They are complete, reliable, durable and ornamental.

The Quaker City Dynamo.

The accompanying cut shows a dynamo built by the Quaker City Electric Co., 240 Carter St., Philadelphia. This design has been adopted for both dynamos and motors to meet the demand for such machines at a reasonable price. The reduction in price has not been gained at the expense of efficiency or durability, but by carefulness in the construction to eliminate all unnecessary and costly features. The company has had a long experience in the construction of dynamo electric machines, and possesses excellent facilities for building them.

By selecting good material and exercising care in its working, machines of uniformly high quality are constructed. The frame and field magnet cores are cast from soft steel of high magnetic quality. The shaft is of large diameter and is made from forged steel. The bearing pedistals are non-removable, being cast with bed-plate. The frame is, therefore, as rigid and substantial as possible, and affords a firm support for the armature shaft. The self-oiling bearings have large oil wells. The brush-holders are self-feeding and of durable construction.


THE QUAKER CITY DYNAMO.

The armature core is laminated; the conductors are of large capacity, and there are large ventilating areas insuring a cool running armature. The commutator is constructed of pure copper segments, perfectly insulated and keyed to shaft. The magnet coils are wound on standard forms, and are afterwards placed in position on the pole-pieces. This construction allows them to be removed at any time with little trouble. The machines, being compound wound, are automatic in regulation. They run smoothly and will operate up to the full rated capacity continuously without sparking or heating.

The Harrington Automatic Magnetic Circuit Breakers

An automatic magnetic circuit breaker may be considered a safety valve for electric circuits. Prior to the development of a line of automatic magnetic circuit breakers, by the Cutter Electrical & Manufacturing Co., Mr. W. E. Harrington, the electrical engineer of the company, made a thorough study of the subject. The results of this study and investigation led to the design of an automatic magnetic circuit breaker which involves original features, and which has met every condition in practice imposed upon it.

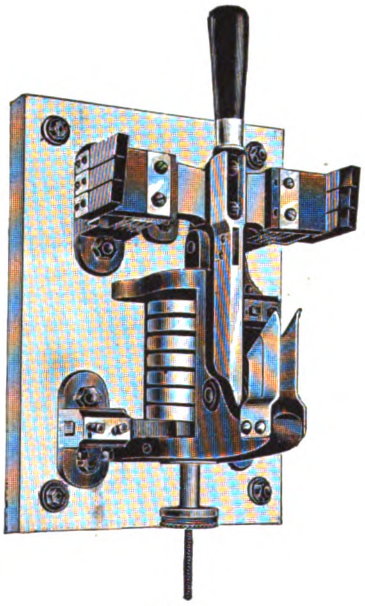


FIG. 1.

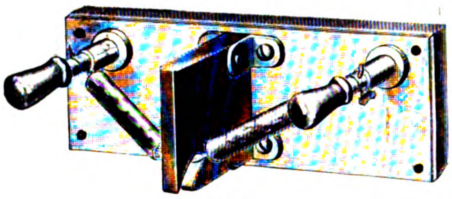


FIG. 2.

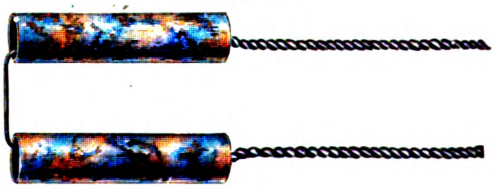


FIG. 3.

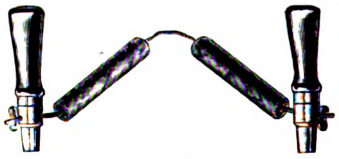


FIG. 4.

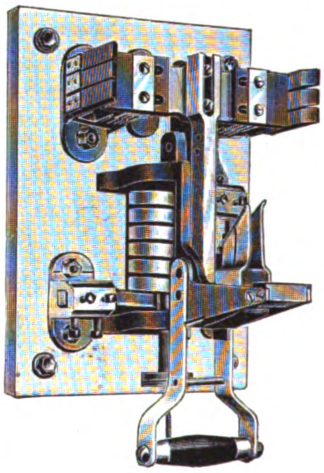
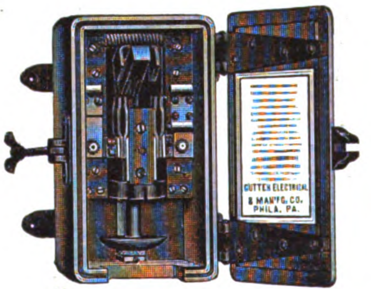


FIG. 5.


CUTTER ELECTRICAL & MAN'F'G. CO. PHILA. PA.
FIG. 6.

THE HARRINGTON AUTOMATIC MAGNETIC CIRCUIT BREAKERS.

Fig. 1 illustrates the standard form, which is adapted for 110-220 volt work. When employed on 500 volt circuits a fuse or shunt block, Fig. 2, is used; the protected terminal fuse, Fig. 3, is connected so as to be in shunt to the main switch break of the circuit breaker, thus preventing the destructive arcing which would otherwise occur at the switch. To facilitate quick resetting of the circuit breaker, extra plugs shown in Fig. 4, are furnished with each shunt block. The protected terminal fuses are the development of years of experimentation, and by their construction the arcing and burning of the terminals so common in the use of ordinary fuses in high voltage work is entirely eliminated.

The salient features of the Harrington automatic circuit breakers are: 1. Freedom from arcing at switch-jaws, thus preventing injury to the contact surfaces. 2. Time element; that is, the time of opening the circuit becomes less and less as the conditions of the circuit protected approach nearer and nearer a short circuit. The device will open circuit in $\frac{1}{100}$ part of a second under the latter condition. 3. Positiveness in opening: That is, if the plunger moves at all, the blow struck is, under all conditions, such that the switch will open. 4. A natural relieving of the load from the generators through the medium of the arc established at the fuse, which is so constructed as to allow of a long arc. It is manifestly incorrect to try to stop the arcing attendant upon opening a circuit by a circuit breaker too suddenly, because if too quickly opened the induced electromotive forces tend to disrupt insulation. 5. Constancy of adjustment, which is due to weights and fixed distances. 6. Safety: Every provision is adopted to insure protection, although having fuse protection; in event of failure of fuse, or forgetfulness on the part of the operator to replace the fuse, the circuit breaker is provided with carbon final break.

Fig. 5 represents a circuit breaker with a special swinging arm handle of such a construction as to permit the placing of the circuit breaker at the top of the switch board.

The Cutter Electrical & Manufacturing Co. have appreciated the desire of the fire underwriters and others, and have designed a full line of circuit breakers made up roughly for house service connections, mine installations and rough factory work. This line, while employing all features and refinement of adjustment of the finer switch board circuit breakers, is made up without any finish and is mounted on plain slate slabs. This rough line is made in both single and double pole patterns, in order to do away entirely with the use of a knife blade switch and fuse blocks.

Fig. 6 illustrates an automatic magnetic circuit breaker designed for the protection of car motor circuits, constructed upon the same general lines.

The R. & B. Vibrating Push Button.

The accompanying cut shows a vibrating push button for which the manufacturers, the R. & B. Manufacturing Co., 1814 Fairmount Ave., Philadelphia, Pa., received a patent last month. The value of such an apparatus will be at once apparent to all who have waited at the door for a considerable time not knowing whether the pressure of the button gave the signal in the house or not. The little vibrator is concealed in the base of the button and makes a clicking noise which is plainly heard by the person pressing the button. If the vibrator is not heard the person will know that the bell does not ring. Much time and annoyance is saved by this little telltale.

THE R. & B. VIBRATING PUSH BUTTON.

The vibrator is connected in series in the bell circuit and its installation requires no extra wiring or batteries. Its construction is simple, consisting of a small magnet and armature. The vibrating bell at the other end of the circuit operates the armature which flies back and forth. This vibrating push takes the place of the ordinary push button and is as easily put up, the wires being fastened under the binding screws as in the ordinary push button. A metallic cap covers the working parts. The use of this push will be found to save the battery since when the signal is heard, the caller will be content to wait, while if nothing was heard he would continue the pressure of the button.

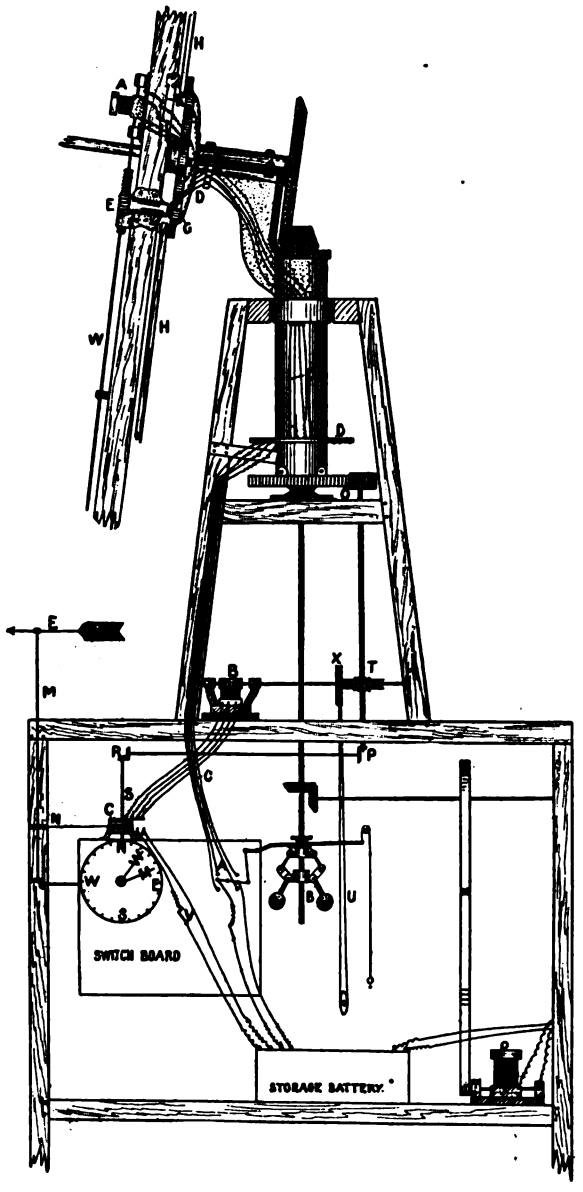
A Self-Regulating Windmill.

Electricity has become an important factor in the transmission of power, and one of the latest applications of it is in a self-regulating windmill, of which the governing mechanism is operated by it. It is the invention of E. M. Schrock, of Pontiac, Ill., and is shown in the accompanying illustration. Mr. Schrock, who has had a great deal of experience with windmills, says that in no place are his appliances of such importance as in the furling and unfurling of the sails of a windmill, for which purpose they are admirably adapted.

Heretofore the furling of the sails in large mills has been done by hand, which necessitated stopping the mill and manipulating the sails one at a time, a laborious task requiring a skillful operator. The electric motor in this mill is a substitute for a man, with the strength of two or three horses. It allows the sails to be manipulated quickly, without stopping, by either a small speed governor or the touch of a button. The operator is on the main floor instead of on the deck, exposed to wind and weather.

Automatic machinery for operating the sails of windmills are in use, and some have been quite successful, especially in controlling wheels of small diameters, while a number of unsuccessful attempts have been made to adapt the same principles to large wheels. Everyone acquainted with the construction of modern windmills knows what an amount of intricate mechanism is used for this purpose. All kinds of sliding heads, push bars and other contrivances have been employed to get the motion for operating the sails from the stationary part of the mill, and Mr. Schrock claims to have solved the problem. He uses a dynamo with a storage battery, which, however, can be dispensed with if the mill can obtain the same power from an outside source. The sails are furled or unfurled automatically whether the mill is running or not, and it enables the wheel to turn to the direction of the wind, no matter how light the breeze may be, doing away with an auxiliary steering wheel, which loses power as it turns its edge to the wind.

The drawing given herewith does not represent the proportions of Mr. Schrock's mill, but serves the purpose of showing the essential features of the mechanism employed in governing a large windmill. The dynamo is run by the mill and the motor is controlled by the reversible switch *A*, which is operated by the centrifugal governors *B* in accordance with the speed of the mill. The current passes to the motor through the wires *C* and brush rings *D*, *D*. The electricity works the worm gear *E*, giving motion to the geared oscillating spider *G* having rods *H* which operate the sails. The stop motion switch *K* breaks the current when the sails are entirely furled or unfurled.



A SELF-REGULATING WINDMILL.

The motor *B* is controlled by a novel reversible switch *C* operated by a small vane *E* having shaft and sprocket wheel and chain *N*. This is also run by the main turning pivot of the mill through the gearing at *O*, *P* and *R* and the shaft *S*. The gearing *P* is speeded the same as at *O*, but is placed in a reverse position; *R* is a miter gear. Thus the motion from the mill communicated to the switch corresponds with the movements of the turntable of the mill. The mechanism of this switch is so constructed that the current is cut off from the motor when the face of the wind-wheel stands at right angles with the course of the wind, and as the wind changes the current is supplied to the motor to shift the main pivot through the worm gearing *T* and gearing *O*, keeping the face of the windwheel to the wind. The dial on the switchboard shows at all times the course of the wind and the position of the windwheel. The hand *M* is moved from the mill power and *W* by the valve *E*.

One of the important features of the mill is the manner in which the wheel is turned to the wind. The entire piloting mechanism is mounted on the stationary part of the mill, is easy of access, and so arranged that it can be entirely disengaged from work by throwing the switch *V*. The main pivot of the mill can then be manipulated by hand through the agency of the endless rope *U* which operates the worm gear *T* through the sheave *X* secured to the shaft of the worm gear. This feature is important, as in case of the accidental breakage in the wheel governing mechanism the wheel can be stopped by bringing its edge to the wind.

Another feature which promotes the safety of the windwheel is the light shaft *W*, which extends from the worm gear *E* to the periphery of the wheel. It is provided with a hand crank (which is not shown) so that the sails can be operated by hand in case the motor or its connections are out of order. Two or more motors can be attached to a windwheel, one to operate the pivoted sails whenever the speed governors indicate a change of speed, while the other can be used to operate the canvas sails and work only when the speed governors reach their highest and lowest points of action. It can also be entirely disengaged in time of high winds, when it is not needed.—American Miller.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. Suggestions and questions will be welcomed and will be incorporated in future parts of the catechism. While it may be difficult to bring out much but what can be found in works on the subject of electricity, it is expected that the method of presenting the subject will be the easiest and quickest understood and that much practical knowledge will be brought out that it would be difficult to gather from other sources. *Copyrighted 1895.* ELECTRICAL INDUSTRIES PUB. CO. Commenced in Vol. 2, No. VI.]

107. *What is the difference between static electricity and current ?*

One is electricity at rest, the other is electricity in motion. When static electricity is properly handled, it will produce most of the results obtained from currents. If the two surfaces of a charged condenser are connected by wire or other conductor, the charge on one surface passes around to the other and unites with or " neutralizes " it. While this discharge is taking place, an electric current is moving through the wire from the positive side of the condenser to the negative side. This current lasts only a short time, usually only a small part of a second, but while it lasts it heats the wire and gives magnetic effects much the same as an ordinary current. Likewise the effects of static electricity may be produced by current electricity if the voltage is very high, several thousand volts. Even with low voltage, some static effects can be produced, as illustrated in answers 94 to 98.

108. *What are the principal sources of current electricity?*

Dynamos or generators, chemical cells or batteries and thermopiles.

109. *What is a thermopile ?*

It is an electrical generator developed from the fact that if a circuit is composed of two different substances, say one section of iron and another of copper, a current will be caused if the two joints between the two metals are not at the same temperature. The thermopile consists of a large number of pairs of metals so arranged that every alternate joint can be heated to a higher temperature than the others.

110. *For what purposes are thermopiles used ?*

The thermopile is used in some cases where a perfectly steady current of several amperes is required, as in chemical analysis. Thermopiles are not used to any great extent.

111. *What is a chemical cell or battery ?*

It consists of two pieces of conducting substances in a liquid that acts chemically upon one more than upon the other. One of the substances is generally a rod or plate of zinc, a metal that is cheap and also easily acted upon by solutions of common salts. The other substance is generally carbon, copper or iron. The solution is generally sal ammoniac or copper sulphate or caustic potash. Sometimes acids are used. The conductor that is least eaten by the liquid becomes positively charged and the other negatively charged.

112. *What is the difference between a cell and a battery ?*

The word " battery " refers strictly to a number of cells coupled together. It is quite common, although inaccurate, to use the word when referring to a single cell.

113. *What is a voltaic or galvanic battery ?*

These are simply other names for chemical batteries. Volta and Galvani are the two men who divide honors for discovering the principle and inventing the battery.

114. *For what purposes are batteries used ?*

Where small currents are used, as for electric door bells, telegraph lines, telephone transmitters, medical purposes and for very small motors.

115. *What is a dynamo ?*

It is a device for changing mechanical power into electricity.

116. *What is the difference between dynamo-electric machines, dynamos and generators ?*

The word " dynamo " is simply a shorter term for " dynamo-electric machine." The word " generator " is more general and may refer to a dynamo or to a battery or any other source of electricity. It is common to use the word " dynamo " when the current is used for operating electric lights, and the word " generator " when the current is used for motors. This usage is simply a custom.

117. *For what purposes are dynamos used?*

For any purpose requiring any considerable amount of energy, such as electric lights, motors, welding, etc.

118. *Are dynamos cheaper than batteries ?*

It depends upon the amount of current needed. Where only small amounts are used, batteries are cheaper. But if the work requires as much as a quarter of a horsepower, or perhaps less, it is cheaper and easier to use a dynamo driven by steam, water or any other convenient power.

119. *How is electricity generated in a dynamo ?*

The exact action is not entirely understood, although enough is known about it to construct working theories and to design machines with accurate and positive knowledge of results. The first principle is a result of the magnetic effect of currents.

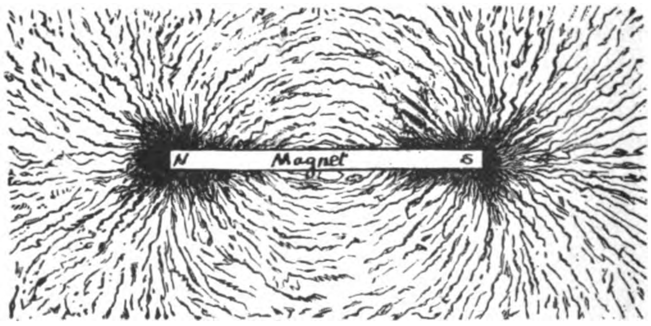


FIG. 23.

120. *What connection is there between a current and a magnet ?*

A magnetic field exists around a current, much like that about a magnet.

121. *What is meant by a magnetic field ?*

This can be illustrated by a simple experiment. Scatter iron filings or chips upon a piece of glass or cardboard placed over a magnet, and then strike the cardboard gently. The filings will gradually arrange themselves in well-defined lines, such as shown in Fig. 23. The arrangement of the iron particles shows that there is some sort of force in the space around the magnet, a force that acts in well-defined directions and that is strongest near the poles or ends of the magnet. If a compass needle or a magnetized steel needle suspended by a hair or thread is moved about near the magnet, it will point in the direction of these lines, showing that there is a field of force all around.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

THE PREVENTION OF THE DESTRUCTION OF WATER AND GAS PIPES BY ELECTROLYSIS.

It is a well-known fact that electrolysis takes place whereever a current leaves the metal. Now it is very evident that if electrical connection be made between point where current leaves metal to that to which current flows, electrolysis would be impossible. Referring to Fig. 1, the current would flow in the direction of the arrows from c to c through the rail, a part being shunted to a pipe through the damp earth. The metal would be wasted away at a and a'. Fig. 2 shows flow after connections have been made. Connections should be made at such intervals as the conditions demand. Where pipe lines cross or are close they should be well bonded together. Fig. 3 shows the system on an enlarged plan. We have had this system in use three years without a sign of electrolysis. We have no supplementary wires or returns, save at power-house, when a larger conductor leads to a single track about one square away, and two large ones leading to a 36-inch water main about two squares from power-house. Connections are made to pipes by copper screw plugs, or by soldering and painting with a good paint the connections. The voltage tests show a very small loss.

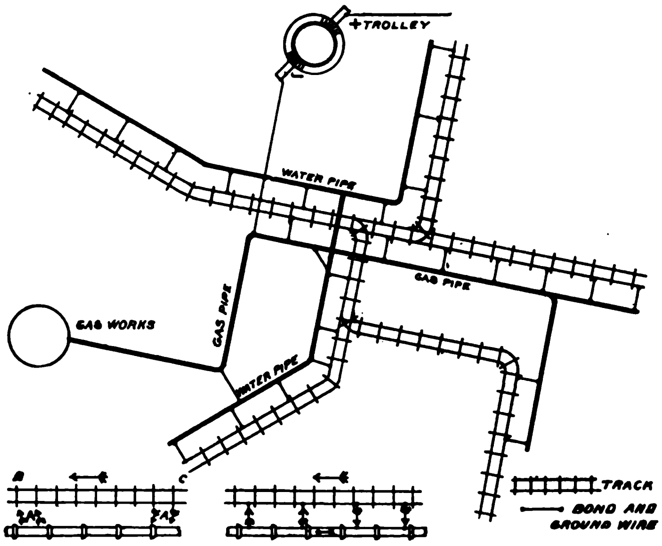


FIG. 1. FIG. 2. FIG. 3.

A. S. Krotz.

Springfield, O.

CUT-OUT IN PRIMARY CIRCUIT.

Such a device as that mentioned by Mr. Grier in the last number of Electrical Industries to cut out the transformers when not in use, should be a money maker. In a large station using the alternating current the amount of energy consumed by the transformers when not in use, although amounting to a small amount in the individual case, gives a total which is considerable. This is a large factor, especially where the system takes in a large residence district, which always is wired for many times the number of lights usually burned. Such a device would necessarily be rather complicated since, if the primary of the transformer was cut off, the lighting circuit would be dead, and an auxilliary circuit or method of communication would be necessary. To be effective such a device should be automatic. When the switch is turned for the lights the same movement should operate the cut-out. If it is dependent on the will of the user, whose meter operates only when the lights are burning, the cut-out would seldom be used. If the meter could be placed outside of the transformer, then the device would not need to be automatic to be used. Under these conditions it would not be so much to the advantage of the lighting company to have such a device. As they are now arranged the company gets no returns for the transformer losses. I do not think that the invention of such a device would be an easy matter, nor do I think that it is impracticable.

B. T.

Bay View.

THE PHOTOMETRY OF ARC AND INCANDESCENT LAMPS.

Your September issue just at hand. The first thing that attracted my attention was Prof. Stine's article on "The Photometry of Arc and Incandescent Lamps." It seems strange that in this age of intelligence that those who are engaged in producing electrical energy should neglect so far the apparatus which delivers that energy to the consumers who pay for the cost of production and profit on the capital invested. The manufacturer of any article should, if he has business intelligence, study the question of the delivery to the consumer. Whatever affects the consumer of any article must necessarily affect the manufacturer.

This is the most important subject that has been taken up in years. I am pleased that you have taken it into serious consideration and have the help of so competent a man as Prof. Stine. Very truly yours,

James H. Seymour.

New York City.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Mansfield, Ohio.—Citizens' Electric Ry., Lt. & Pr. Co. will relay two miles of track.

Norwalk, Conn.—Norwalk St. Railway Co. expect to make extensive improvements in the spring.

Toronto Junction, Ont.—Toronto Suburban St. Ry. Co. contemplates extensions to Lambton and Islington.

Keokuk, Ia.—The Keokuk Electric Railway Co. will extend its tracks about one-half mile in the near future.

Birmingham, Ala.—Birmingham Ry. & El. Co. propose to change its Lake steam line to electric, about seven miles.

Burlington, Vt.—Military Post Electric St. R. R. Co. will construct immediately about four and a half miles of street railway.

Beatrice, Neb.—Beatrice Rapid Transit & Pr. Co. will build three miles new electric road and will also increase its lighting equipment.

Springfield, Mo.—Robbinson Ave. Ry. Co. will lay one and a half miles new track to Dolings Park and a half mile to Normal School.

Los Angeles, Cal.—Los Angeles Railway Co. contemplates changing its cable lines to electric and will then enlarge its power-house.

Ocean View, Va.—Norfolk & Ocean View R. R. & Hotel Co. will extend its railway to the end of Willoughby Spit, about two and a half miles.

Pomona, Cal.—Orange Grove St. Ry. Co. contemplate the change to electric power, and as the city increases the road will be considerably extended.

Pittsburg, Kan.—Pittsburg, Fountenac & Sub. Elec. Ry. Co. will build four or five miles of new road under charter to Kansas & Missouri Elec. Ry. Co.

Lancaster, Pa.—The Pennsylvania Traction Co. has under consideration the construction of nearly 40 miles of suburban and inter-urban electric railway.

London, Ont.—London St. Ry. Company is now changing from horse-power to electric, which will so improve its lines as to place them in much better position to handle its growing traffic.

Bowling Green, Ohio.—Bowling Green Elec. Lt. & Pr. Co. will erect a new station and build a street car line from Bowling Green to Portage, three miles south, and north to Perrysburg 13 miles, to connect with electric line for Toledo.

Plainfield, N. J.—Plainfield St. Ry. Co. has secured additional franchises for seven miles of streets on which lines will be constructed. A part will be built this fall and a part in the spring.

Cincinnati, Ohio.—Pendleton, McCook & East Walnut Hills St. Ry. Co, whose lines are now operated by steam, will be changed to electric power this year, and lines will probably be extended three miles.

Waterloo, Ontario, Can.—The Berlin & Waterloo St. Ry. Co. is about to extend its lines to West Side Park, a pleasure resort covering 66 acres and containing lake, ball grounds, bicycle track, groves for picnics, etc.

ELECTRIC LIGHT AND POWER.

EXTENSIONS AND IMPROVEMENTS.

Ravenna, Ohio—Ravenna Gas & El. Lt. Co. will put up about 3,000 feet of new lines.

Eaton, Ohio.—The Eaton El. Lt., Pr. & Ice Mfg. Co. will add both arc and alternating dynamos to its plant.

Warrensburg, Mo.—Magnolia Lt., Heat & Pr. Co. expect to add a 2,000-light alternator to its equipment this winter.

Delphos, Ohio.—Delphos Elec. Lt. & Power Co. is about to place a Bates-Corliss engine of 250-horse power in its plant.

Galion, Ohio.—Galion Elec. Lt. Dept., Walter Marlatt, Supt., will increase by incandescent generators 1,500 to 2,000 lights.

Oklahoma, O. T.—Oklahoma Gas & El. Co. will install a 3,000-light, two phase alternator this fall, current at 2,000 volts, which will be reduced to 100.

Jackson, Ohio.—Jackson El. Lt. Co. will place a new 75-light arc dynamo in the plant within a short time to care for the increased business of the station.

Haddonfield, N. J.—Haddonfield Elec. Lt. & Pr Co. is making extensive improvements, including both arc and incandescent generators and power apparatus.

Chicago Heights, Ill.—Chicago Heights Electric Co will run power circuits as soon as a sufficient number of customers are received to make it profitable.

Painesville, Ohio.—City Plant. The subject of more lights is under discussion. If they are put in plant will have to be enlarged. Engines and generators will be needed.

PERSONAL.

Mr. Percy A. Clisdell is manager and purchasing agent of Rapid Railway Co., of Mt. Clemens, Mich.

Mr. Thomas G. Grier, Chicago, has been seriously ill during the past month, but is now convalescent.

Mr. James W. Godfrey, sales manager of the India Rubber & Gutta Percha Insulating Co., returned from Europe last month.

Mr. J. S. Richards, president and manager of the Marshall Electric Co., Marshall, Ill., was a recent caller at the offices of Electrical Industries.

Mr. A. H. Blackburn, general manager of the Fuel Economizer Company, of Matteawan, N. Y., spent several days last month in Chicago in the interests of his company.

Mr. Geo. F. Morrison has recently been promoted from the position of assistant superintendent to that of superintendent of the General Electric Co.s lamp works at Harrison, N. J.

Mr. Allen R. Foote, well-known through his various writings and also his connection with the U. S. census department, has accepted the editorship of the American Exporter, New York.

Mr. Chas. E. Gregory, president of the Chas. E. Gregory Company has recently been in poor health and will therefore take a much needed vacation for a short time, in order to be relieved from his many business cares.

NEW BOOKS.

Elements of Geometry. Plain and Solid. By John Macnie. Edited by Emerson E. White, 1895; New York and Chicago: The American Book Company; 375 pages; price, $1.25.

This volume, which is intended for a text book, does not differ materially from previous works on this subject. It has a freshness, however, in matter and make-up that commends it to the student. The diagrams have been very clearly drawn, and in size they are sufficiently large to be plain without taking up an unnecessary amount of space. The signs and symbols have been well selected. The theorems follow in logical order and definitions, suggestions and diagrams assist the student.

The Forces of Nature. A Study of Natural Phenomena. By Herbert B. Harrop and Louis A. Wallis, Columbus, Ohio; 1895. Harrop & Wallis. Cloth; 160 pages; price —.

A book for the general reader; treating in a concise and popular style natural phenomena. It is not intended for a thorough study of the subject, as that would require many times the space which this volume affords. Many persons without the time or inclination to pursue a systematic study of these subjects will find this brief and cursory treatment of these scientific subjects to their liking. In the first chapter the solar system is considered, with a description of the sun, moon and stars and their motion in space. The atmosphere, its composition and general phenomena is described in the second chapter. The earth, its nature, light, heat, sound, electricity and magnetism are some of subjects treated also in Part One. The subsequent pages, Part Two, are devoted to a series of paragraphs and short essays on subjects of interest.

The Principles of Physics. By Alfred P. Gage, Ph. D. 1895, Boston, Ginn & Company. 12 mo., 635 pages; price $1.45.

This volume has been designed as a text book for high schools, but to the text for this course has been added supplementary notes in smaller type for more advanced students. The previous experience of the author in the making of text books has undoubtedly aided in the production of the present book. He has presented the laws and theories of the science and illustrated them by easy experiments in a way quite different from that followed in the usual text book on this subject. It is written in a comprehensive, readable style which will make it interesting to the student. The illustrations have been tastily executed and are quite free from the trade catalogue stamp which is so conspicuous in many works on technical subjects. The sections devoted to electricity and magnetism, in which sciences great advancement have been recently made, are up to date and include mention of the more recent discoveries. These chapters form some of the more recently interesting parts of the book. The text gives evidence of careful work and the arrangement of the mater is excellent.

Poor's Manual of Railroads for 1895. The Twenty-Eighth Annual Report. New York, H. V. & H. W. Poor, 44 Broadway. Chicago, A. C. McClurg, & Co. Price $7.50.

This publication, which has become well known during the many years since it was first issued, grows larger and better each year. It contains detailed statements of the steam roads of the United States, Canada and Mexico; statements of the financial condition of the United States, the several states and chief cities, counties, etc., in the United States; statements of the movements of the principal stocks, bonds and other securities, and the history, mileage, operation and condition of the leading street railways in the United States. It is a universally recognized reference book on the finance of the leading corporations of the country. The imformation is presented in the most compact form yet the statements are complete. The amount of information between its covers is wonderful. In the concise and plain statement of the facts lies one of the most important features of this work. The index facilitates the finding of the report of the desired corporation and the condensed report meets every requirement of the financier. Few large works of this kind open so easily to the enquirer.

TRADE PUBLICATIONS.

The recent catalogue of the Deane Steam Pump Co., of Holyoke, Mass., describes and illustrates a number of types of steam and power pumps for boiler feeding and for both heavy and light service. Duplex, triplex and general purpose pumps of a variety of patterns are included in the list, which shows that the company is up to date with its goods, many new styles and improvements in all being noticeable among the pumps listed.

Recent circulars of Fraser & Chalmers, Chicago, contain information regarding the extensive lines of machinery built by them. Particular attention has been given to mining machinery, pumping and power plants and an extensive line of such goods are listed. Not only are special parts constructed, but also entire equipments for pumping stations and mining plants. Improved methods are evident in many of the processes. Special designs are also prepared for particular cases and plans prepared under the direction of competent engineers for plants under conditions for which ordinary equipments do not meet the requirements. The numerous branches of the company in the different sections of the country places it in touch with every industrial movement.

The September Review of Reviews contains among other interesting articles a contribution from Mr. Arthur V. Abbott on "Industrial Niagara" and an unsigned article on "Nikola Tesla and the Electrical Outlook." The first deals with the enterprise of the Niagara Falls Power Company, and the utilization of the power of the falls in industries near and at a distance from the power plant. Several views of the power house accompany the article. The latter deals with the inventions of Tesla, especially that of the two phase motors and transmission system.

Catalogues recently received from the Ziegler Electric Co., Boston, Mass., contain lists of physical and chemical apparatus designed for the use of educational institutions or for private investigation. The catalogues are well gotten up in a neat and attractive style. The supplementary catalogues embrace a distinct line of goods, so that persons desiring an article will not be burdened with a bulky volume when making their selection. The line of electrical apparatus for illustrative and experimental purposes is most complete, and contains many articles exceptionally well designed for this purpose.

A pamphlet, recently issued by the Ransom Subway Company, of Chicago, describes the Ransom system of monolithic construction of sewers, electric conduits, drains, cable and electric roads, ditches, waterpipes, tunnels, etc. The text is accompanied by numerous illustrations showing the methods employed and the structure as completed. The system includes combinations which provide for sewers, electric mains, etc., and which are all constructed in the same trench at the same time. The advantages of this method of construction are set forth, and a number of testimonials from engineers are appended setting forth the results of their examination and test of the systems.

Turret lathes are illustrated in a recent catalogue of the Gisholt Machine Company, of Madison, Wis. The illustrations are remarkably good and show clearly the different parts of the machines. The description covers the various details of the lathes, the tools used and the class of work that may be turned out. What, however, is more important to the manufacturer is given in the latter part of the catalogue, cuts of different kinds of work done with the time required to do it on this machine. From this data the cost of almost any kind of work may be estimated and a comparison can be made between this improved form of lathe and such lathes as may be in the machine shop.

The courses of instruction of the A. Van der Vaillen's School of Engineering, 723 Market St., San Francisco, are described in circulars recently received. The electrical department was established in 1891 and has reached its present development by the gradual acquisition of apparatus and material. The opportunity for such a schools which was at that time evident on the Pacific slope, was immediately embraced, and since the department was established there have been graduated many young men who are now occupying remunerative positions as electrical engineers. The department has an equipment which include a variety of dynamo electric machines, test instruments, batteries and experimental apparatus, etc. The school offers courses in mining engineering, civil engineering, mechanical engineering, assaying, and special courses.

A delightful trip to the south and the Cotton States & International Exposition is described in a handsome circular recently issued by the Chicago & Eastern Illinois R.R. It takes the traveler over the shortest route (by 55 miles) from Chicago to Atlanta; leaving Dearborn station over the Chicago & Eastern Illinois R.R., at 5 P.M., passing through the least interesting part of the journey to the tourist at night. Lookout Mountain, the Cumberlain Range, Missionary Ridge, Murfreesboro, Tullahoma and Bridgeport are reached during broad daylight, together with many other places made famous by conflicts during the Civil War. These points call up remembrances which keep the traveler interested until Atlanta is reached at 6:15 P. M. Special rates are made over this route, giving sufficient time to see the exposition and many of the cities and resorts of the south of particular interest. These trains are vestibuled and include Pullman sleepers and dining cars which afford every comfort to the traveler. The return journey is made with the same degree of comfort and despatch. This folder, which has a very handsomely designed front page, into which is worked a bird's-eye view of the exposition grounds, may be had upon application to C. L. Stone, general passenger agent, Chicago, or C. W. Humphreys, northwestern pass. agent, St. Paul, Minn.

FINANCIAL.

The Westinghouse Machine Co. has declared its regular quarterly dividend of 1½ per cent on the preferred and common stock, payable October 1.

The date for the sale of the manufacturing plant of the Schuyler Electric Co., at Middletown, Conn., is October 15th. The plant may be sold at private sale, if reasonable offer is made before that date.

The Standard Underground Cable Co. has increased its annual dividend rate from 6 to 8 per cent, or from 1½ per cent to 2 per cent quarterly. The company's condition and outlook were never better than at present. The dividend is payable October 10.

The New England Engineering Company, Chicago, of which Jos. H. Hoadley is president, has brought suit in the circuit court of Ohio, against the Oakwood Street Railway Company of Dayton, Ohio, Chas. B. Clegg, president. The amount involved is $20,100. The plaintiffs have placed a mechanic's lien on the entire property of the Oakwood Street Railway Company and had injunction issued prohibiting the operation or removal of the power plant. The Oakwood Company has been compelled to hire power from the City R.R. Co. to operate their cars pending the decision of the court.

The plaintiffs have retained the well known firm of Harmon, Colston, Goldsmith & Hoadley of Cincinnati, Ohio; Wm. W. Cook, the noted attorney of New York City (counsel for the Postal Telegraph Company and John W. Mackay). Mr. Cook is well known through this section of the country by having carried the Detroit St. Ry. Co. to victory in the face of the most violent opposition. Mr. Geo. S. Graham, the prominent district attorney of Philadelphia, and who is chief counsel for so many of the large Pennsylvania corporations, will give his personal attention to this case.

Mr. C. B. Clegg stated that he had retained Col. David Corwin, the well known lawyer of Dayton and the president of the City Ry. Co. of that city. Col. Corwin is a veteran in the profession and is sure to make a hard fight.

BUSINESS NOTES.

GRIER BROS., western managers for the Bryant Electric Co., have just moved their offices to 1436 Monadnock Block.

THE SUNBEAM INCANDESCENT LAMP CO., Chicago, announces change of officers as follows: H. B. Vanzwoll, elected secretary in place of F. S. Terry, who is now vice-president of the company.

MR. ALBERT FISHER, formerly of the firm of Fisher & Porter, retains the old offices of the firm at 1025 Monadnock and represents Wm. Todd & Co., on their engines, rolling mill and blast furnace machinery.

THE CROCKER-WHEELER ELECTRIC CO., Ampere, N. J., has been running its factories continuously to catch up with orders which have nearly doubled since the fire last summer at the works. The company has nearly replaced its stock of parts and is able to serve customers with promptness.

MR. H. F. J. PORTER has recently opened offices at 1433 Marquette Bldg, representing the Bethlehem Iron Co. Mr. Porter was formerly associated with Mr. Fisher in the firm of Fisher & Porter, which was dissolved by mutual consent Sept. 30.

THE CHICAGO GENERAL FIXTURE COMPANY, Chicago, is now exploiting the Bergmann arc lamp and the Phoenix transformer and is meeting with abundant success in its sales of these two excellent specialties. The manager of the company, Mr. F. Overbagh, reports the outlook as very encouraging.

THE HOBART ELECTRIC MFG. CO, Middletown, Ohio, is about to take possession of its new shops at Troy, Ohio. The company manufactures direct current dynamos from 10 to 1,000 light capacity and motors from one to 150 horse power, both bipolar and multipolar. Woven wire brushes with graphite filling are also manufactured.

ANDREWS & JOHNSON COMPANY, the well-known heating and ventilation engineers, Chicago, have just contracted with the Western Electric Company for heating its new building throughout with their hot-blast system. This firm report business good for this season of the year, their business during the year having been very much better than that of last year.

THE ZIEGLER ELECTRIC CO., 141 Franklin St., Boston, Mass., handles besides its many scientific and electrical apparatus a steel spring corboy rocker which can be attached to any corboy and permits the contents to be poured in any quantity without danger of spilling or soiling the clothes of the user. It is a simple affair but very useful in storage battery plants and factories.

THE OKONITE COMPANY, LTD., New York, makes a specialty of feeder wires for street railway use. They are tough and tenacious and are not affected by extreme changes in temperature. Okonite has made an enviable record both in this country and abroad and is deservedly the most popular insulation known to the electrical fraternity. It is strictly high-grade, and "never disappoints."

THE TRUMP MANUFACTURING CO., Springfield, Ohio, is the new name of the W. C. Leffel company since its reorganization. The company will continue the manufacture of the Model turbines, the Leffel wheel, steam engines, boilers and other machinery. The followling officers were elected: President, John J. Hoppes; vice-president. Wm. Conklin; general manager, Fuller Trump and treasurer, Paul A. Staley.

CHAS. A. SCHIEREN & CO., the leather belt manufacturers, of New York, Boston, Philadelphia and Chicago, shipped a large exhibit of their products to the Cotton States and International Exposition opened last month at Atlanta, Ga. The exhibit will consist of large main driving belts of their Electric and Perforated Electric brands, also dynamo belts, and belts for saw mill and cotton mill work. The largest belt running at the exposition will be a main drive 36 inches wide, and will be a Schieren perforated electric. This concern will also have ten or a dozen of their perforated "Electric" belts in actual use running on dynamos.

The Louis K. Comstock Company, 1437, 1438 Monadnock Block, Chicago, has recently had its offices re-arranged which has greatly improved their appearance and convenience. The company reports besides large contracts under way at Cleveland, Pontiac and Buffalo a number of others in prospect which will give them a busy season. As consulting and supervising engineers a number of important commissions are being filled.

The Bradford Belting Co,, Chicago, has added to its business an electrical supply department, including electric light, street railway, telephone, telegraph and fire-alarm and signal supplies. The company intends to carry only such goods as by good service have made a reputation. Thus standard goods of the highest quality will find a place in their warerooms. Reasonable prices and fair treatment are promised to all who may give them their orders.

Engene Munsell & Co., 218, Water St., New York, miners, importers and dealers in mica have recently sent out to the trade a novelty—a hanger of mica in the shape of a commutator segment which tells you where to buy stamped solid sheet mica segments when in need. The trade, however, has found out so well where to buy mica that the above firm has been obliged to add 2,600 square feet of space and put in three new presses to keep up with orders.

The Triumph Electric Co., Cincinnti, Ohio, has at the Atlanta Exposition 12 machines in the machinery department, besides those in its exhibit in Electricity building which is in charge of Mr. E. F. Seixas, the manager of the Atlanta office. The company now has on its books orders to the full capacity of its present works, which are to be shortly enlarged. Among recent installations is a plant of two 65 kilowatt direct connected machines for one of the largest shoe factories of Chicago.

The Electric Appliance Co., 242 Madison St., Chicago, has out a catalogue of the Upton arc lamps which are made for constant current, constant potential, direct and alternating current circuits. A pamphlet will also soon be out containing a report of Prof. Thomas' exhaustive tests of the Packard incandescent lamp. In both lighting and railway supplies as well as in telephone material, the company is having a good trade, the large stock carried at Chicago warerooms enabling prompt shipment to be made.

The Chas. E. Gregory Company, Chicago, at its recent meeting of directors, elected Mr. A. Louis Kuehmsted secretary and treasurer in place of Mr. S. B. Parmly, resigned. Mr. Kuehmsted recently purchased an interest in this prosperous company and will hereafter take an active part in its management, he having had an extended practical experience in addition to being a graduate from Cornell University. The business of the company otherwise will remain practically the same, Mr. Gregory still retaining his active interest.

The Gates Electric Manufacturing Co. of Chicago, Ill., are putting on the market an excellent line of multipolar generators and motors. J. Holt Gates, known as "Gates of Chicago," is president of this company, and Adolf Lissau, formerly chief electrician of the Siemens & Halske Co., is superintendent. The Gates company is making a very high grade of machines, as is evidenced by their recent sale to Fraser & Chalmers, after much competition, of a 75 horse-power 250-volt moter to replace a large motor of another make. The company also reports the sale of a 100 and a 75 kilowatt railway generator, a 60 kilowatt 250 volt generator, a 60 kilowatt 125 volt generator, three 20 kilowatt dynamos, besides several motors.

Mr. Alfred M. Walter has just returned home to Chicago after an absence of several months in the east. Mr. Walter has, after several years' experience in the supply business, having also been connected with the General Electric Company in testing and assembling large generators, decided to take up an engineering line of work. He has for that reason fitted up in a very neat and convenient manner offices in the Rookery, Chicago, at number 851. A specialty he will make will be testing electrical and mechanical appliances and the development of new devices of all kinds. The field he has entered upon is a wide as well as very promising one. He has made a special study of theoretical electricity for a long time, and the experience already mentioned which, with his extended experience in the electrical department at the World's Fair, will fit him for the work he has undertaken. Mr. Walter first started in business with Mr. Geo. Cutter, some seven years ago, in model and experimental work. We predict for him success, as he is a young man of excellent ability and ample financial resources.

The American Wheelock Engine Company has opened new offices in the Postal Building, New York City. It is authoritatively stated that the treasurer, Mr. J. H Hoadley, will be stationed hereafter in New York; and the New York offices will be frequently visited by Mr. Edw. S. Cramp, the president of the company, and the noted ship builder of Philadelphia. The American Wheelock Engine Company purchased the interests of the Wheelock Engine Company on May 1st, and have arranged to enlarge the Worcester works to some considerable extent. This company now has under construction: One 1600 horse-power vertical cross compound engine for the Edison Illuminating Co. of Boston, Mass.; one 400 horse-power tandem compound engine for A. C. Lawrence & Co., Boston, Mass.; one 1600 horse-power cross compound engine for the Chicago North Shore Ry. Co., known as the Yerkes Syndicate, Chicago; four 1250 horse-power cross compound engines for Toledo Traction Company, Toledo, Ohio; one 600 horse-power cross-compound engine for Grinnell Manufacturing Co., New Bedford, Mass; one 1200 horse-power cross-compound engine for the South Chicago City Railway Co., St. Chicago, Illinois. All the above engines are built after the "Rockwood System" and under guarantees to develop the horse-power in less than 13 pounds of steam per horse-power per hour. One 400 horse-power high pressure engine for the Portland & Cape Elizabeth Ry. Co, Portland, Maine; one 200 horse-power engine for the Polytechnic Institute, Worcester, Mass.; one 1500 horse power, one 3200 horse-power, one 1800 horse-power and one 900 horse-power, all high pressure engines, for the Illinois Steel Co., Joliet and South Chicago, Illinois. Four 1250 horse power Hoadley compound wind systems, rope transmission, for the Toledo Traction Company, Toledo, Ohio; one 1800 horse power, one 2000 horse-power, one 1200 horse-power and one 1500 horse-power transmissions, for the Illinois Steel Co., to be used for driving their twin rod mills, at Joliet, Illinois.

The General Electric Co. has undertaken to install an electric power system for the Boston Duck Company of Bondsville, Mass., the mills of which are now operated partly by water and partly by steam. From the water they are able to derive about 600 horse power over their present steam plant, consisting of two 250 horse-power engines; one being run condensing and furnishing power alone, the other, non-condensing and being used partly for power and partly to furnish exhaust steam to the dye houses. The dye houses, however, require the exhaust steam from about only 100 horse-power. Thus if the power were not required in the mill to help out the water wheels, the condensing engine could be shut down entirely and the other engine could be run at about half its capacity only. Three thousand feet below the mill this company own another water privilege on a difference in level of 22 feet. This was developed some years ago, and the company even went to the expense of building a foundation for a mill before they decided to give up the project. Since that time electricity has come upon the scene and the heretofore unutilized water power has now become of considerable value. Wheels are to be set up in the unused mill and 500 horse-power is to be transmitted back to the mills at present in operation at Bondsville. This will enable them to dispense almost entirely with their present steam plant. This new plant will consist of one three phase 400 K. W. 900 volt generator and one synchronous motor of similar size which will develop 485 horse-power on its pulley. The loss in the line has been calculated at about 3 per cent only. In estimating the economy effected by the introduction of electricity, the Boston Duck Company, has announced that it will not count the cost of the development of the second water power made in 1880, when calculating the operating expenses of the completed plant, as the money put out for the hydraulic improvements cannot be recovered and will not therefore be counted in as part fo the present development.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED—Young man wishes situation in an electric light plant. Has had experience with dynamos and engines and is at present engineer of a large plant. Address Engineer, care Electrical Industries, Chicago.

WANTED—Position as superintendent of a central station by a mechanical and electrical engineer with eight years' experience, and a thorough commercial knowledge of the business. Address Competent, care Electrical Industries, Chicago.

WANTED—Position wanted as superintendent by a practical and experienced central station man, having been in charge and understanding the different departments and leading systems of lighting; also the economical management of steam plants. First-class recommendations from responsible lighting companies. Address Superintendent, care Electrical Industries, Chicago.

WANTED—Position with street railway, as manager, superintendent or electrician. At present electrical engineer of a forty car system. Experienced in construction and maintenance of street railways and power houses. Can furnish the best of references as manager, superintendent, etc. Address K. H. S., Electrical Industries.

A new process for the manufacture of a standard line of goods has been successfully tried by the inventor, who has received orders far in excess of the capacity of his shop. He desires a man with means to take hold of the business. Parties desiring to investigate may be placed in communication by addressing this office.

WOVEN WIRE BRUSH.

The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. November, 1895. NEW YORK. No. 11.

The New Electric Lighting Plant of the City of Chicago.

At Halsted St. and Blue Island Ave. the City of Chicago has recently erected an arc lighting plant. This plant has been built to take the place of the old Throop St. plant, which was purchased by the Metropolitan West Side Elevated Ry., the plant being located on its right of way. The plant will furnish light for the same west side district, in which are located about 500 arc lamps. The Throop St. plant was illustrated and described in ELECTRICAL INDUSTRIES, Vol. V., No. 2. The entire plant having been sold with the real estate an entirely new equipment was purchased for this station. The building is a substantial brick building. The roof is of Spanish tile supported on iron trusses. Brown stone has been used in the ornamentation of the front and in the arch above the door an elaborately carved stone has been placed and across the front of the building "City Electric Lighting Station" has been cut. The building is very long and narrow as is indicated in the floor plan shown on the next page. It has a width of fifty feet and a length more than four times as great. The boiler plant is located at the west end, where is also located the store rooms. The balance of the building is taken up by the engine and dynamo room, which is 144 feet in length. The station has a frontage on Blue Island Ave., as well as Halsted St. The large stack is placed without the building, just south of the battery of boilers. To the north of the building are the coal sheds, where the supply of fuel is stored and wheeled in barrows to the boiler room, as it is required.

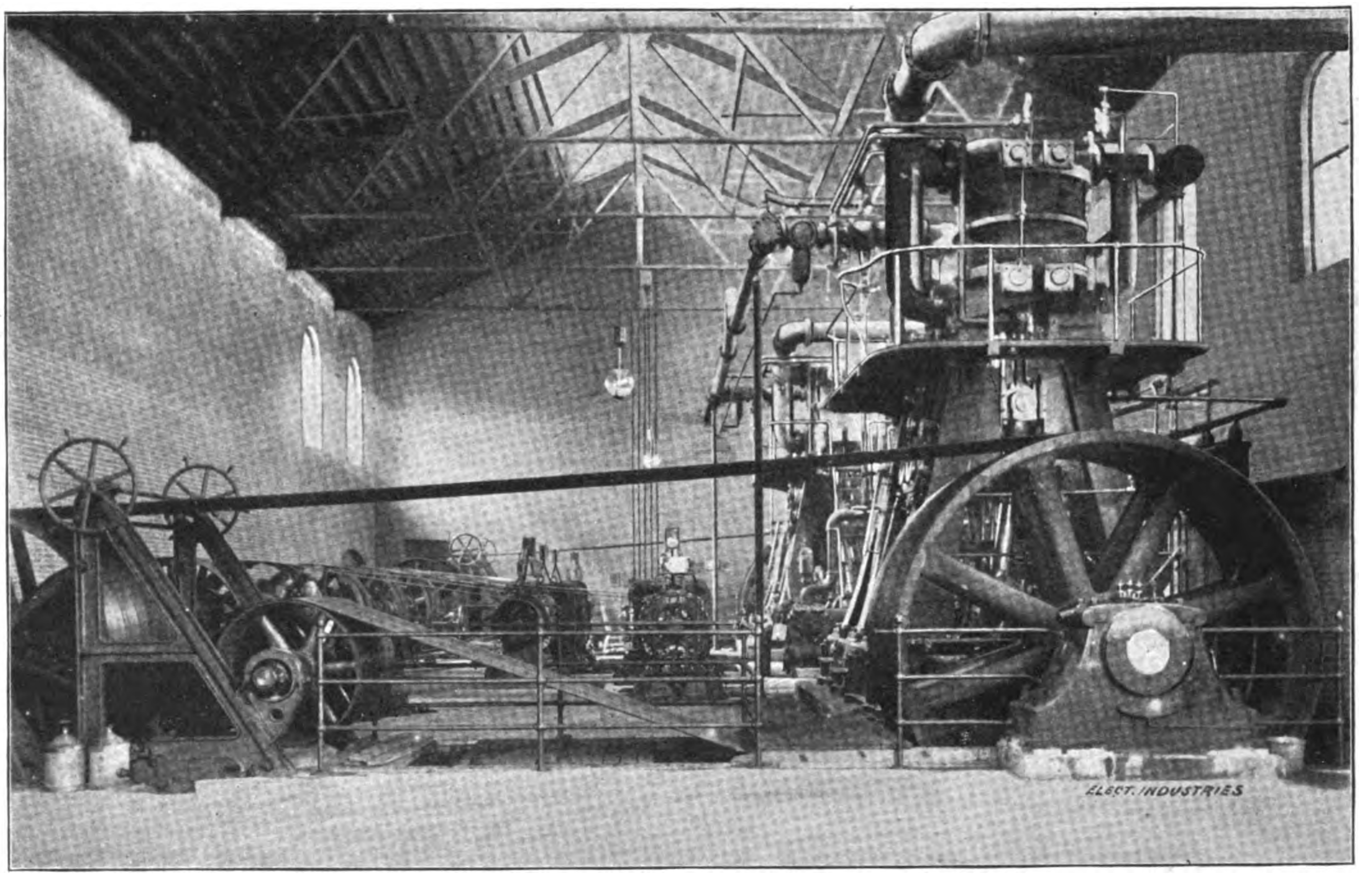


FIG. 1.—THE NEW ELECTRIC LIGHTING PLANT OF THE CITY OF CHICAGO.

The smoke stack, which is the most conspicuous feature of the building from the outside, is one hundred and sixty-five feet high. The details of its construction are best illustrated in the detail drawing, Fig. 2. The height and weight of the stack required a very substantial foundation, which in Chicago and vicinity requires a special construction to obtain. Sixteen foot piles were first driven to a considerable depth, upon which was placed fifteen feet of concrete. This is of sufficient area to accommodate the flaring base of stack, which is twenty-four feet square. The stack is securely anchored to the concrete and is made of steel plates that vary in thickness according to the height at which they are placed. The interior of stack is lined with fire brick. An iron ladder on the side affords a means of reaching the top of stack or any intermediate point. The stack has a diameter at the top of ninety-six inches. It seems to be well constructed and gives a good draft to the furnaces.

The smoke connections are constructed of steel plate and enter the stack at a height of fifteen feet above the ground. The boiler plant includes two six hundred horse-power water tube boilers of the Heine type, as shown in Fig. 4. They were built by the Heine Safety Boiler Co. of St. Louis in accordance with their usual practice. The boiler is made up of a series of lap welded wrought iron tubes, opening at each end into water leg or headers, which are in direct communication with the two shells or water drums placed above. The tubes and drums are so arranged with respect to the furnace and the path for the escape of the gases to the chimney that the maximum amount of water surface is traversed by the hot gases. The boiler room will accommodate another boiler of equal size. The boiler room contains no apparatus besides the boilers. The pumps, feed water heater, etc., are located in the engine room.

The engine room contains the remainder of the equipment with the exception of the siphon condensers, which are located on the north side of the building. These condensers give a vacuum of 26½ inches. The most conspicuous features of the engine room are the large vertical engines built by the Rankin & Fritsch Machine Co. of St. Louis, Mo. These engines are cross compound condensing of 600 horse-power each, belted to large pulleys on a jackshaft, placed on the opposite side of the room. The cylinders are 20 and 40 inches, with a piston stroke of 28 inch. The valves are a modified Corliss.

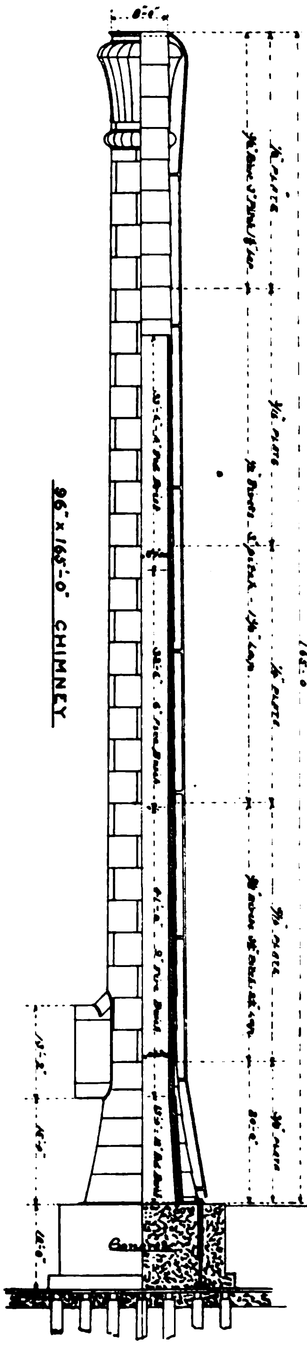


FIG. 2.—THE NEW ELECTRIC LIGHTING PLANT OF THE CITY OF CHICAGO.

The governor is another important feature of these engines. An ordinary Porter-Allen ball governor run from the main shaft operates a check valve in a water system, by means of which the hydraulic piston is raised and lowered as the speed is greater or less than the normal. This piston changes the position of the eccentrics whereby the valve rods are moved and the point of cut off delayed or hastened. This form of governor is reported as very sensitive and during tests at the station with a large bank of lamps for a load the regulation was nearly perfect. The engines have large, massive frames supported on broad, substantial bases. The main driving pulley is placed without the engine frame and is supported on shafts turning in the out board bearing as shown in Fig. 1. The steam valves are reached from the broad iron walls surrounding the cylinders, up to which a broad iron stairway leads from the main floor.

Between the two engines are placed the Worthington pumps, the feed water heater, etc. Everything is in duplicate with the exception of the heater and so piped that they can be used in connection with either engine. The main steam pipe is carried above the line of the engines and has been put up in such a way that should another engine be installed it can be continued along the same line. The exhaust pipes pass directly through the wall of the building to the siphon condensers. The water of condensation is pumped through the heater, where it is further heated by the exhaust from the pumps. This heater and the condensers were built and installed by Wm. Baragwanath & Son of Chicago. This is one of two instances where the excellence of home products was appreciated and Chicago manufacturers awarded contracts in the equipment of this city plant. Water from the city mains is used

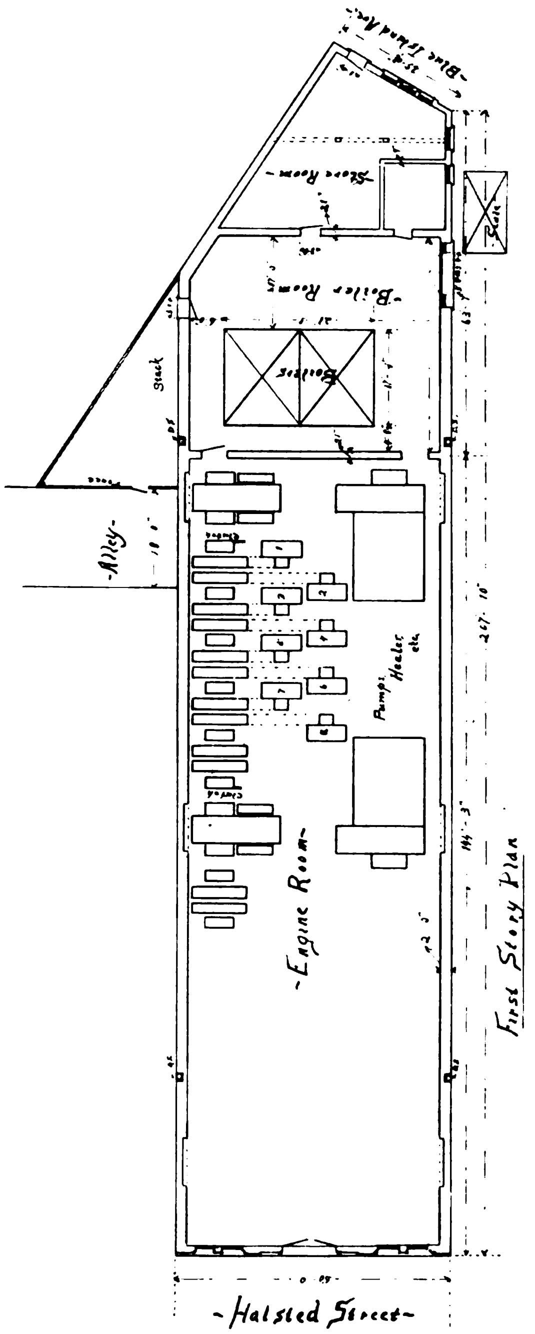


FIG. 3.—THE NEW ELECTRIC LIGHTING PLANT OF THE CITY OF CHICAGO.

in the condensers. The engine room also contains a large pump with a capacity of 900 gallons per minute.

The arc machines, of which there are eight, are all of improved types of 100 light dynamos. Four were furnished by the Brush company and four by the Western Electric Co., of Chicago. These are four pole machines, with the large ventilated commutators. The wires pass immediately from the machines into the conduit laid in the concrete floor leading to the switchboard near the east end of the engine room. These dynamos are belted to the large shaft at the south side of the building. The arrangement of the station is best shown in the floor plan, Fig 3. This shaft contains between the large driving pulleys ten smaller pulleys in pairs. Next to the driving pulleys at each end are friction clutches by which the shaft may be cut off or on and driven by either engine. Each of the smaller pulleys is provided with a clutch, so that anyone or any number of dynamos may be operated at the same time. The belts for this plant were furnished by the Chas. Munson Belting Co. The two main driving belts are more than 100 feet long and 56 inches wide. There are said to be 500 lights in this district or the capacity of five dynamos. The plant has, therefore, three machines in reserve.

The shaft, pulleys and clutches were built by the Hill Clutch Works, of Cleveland, Ohio. The clutches are of the new type, with broad webbed arms which give them a strong and more symmetrical appearance. Special foundations were put in for this shaft, and, with that the exception of the main driving belts, all the belts run above the floor. The cement floor is laid on a level with the dynamo foundations.

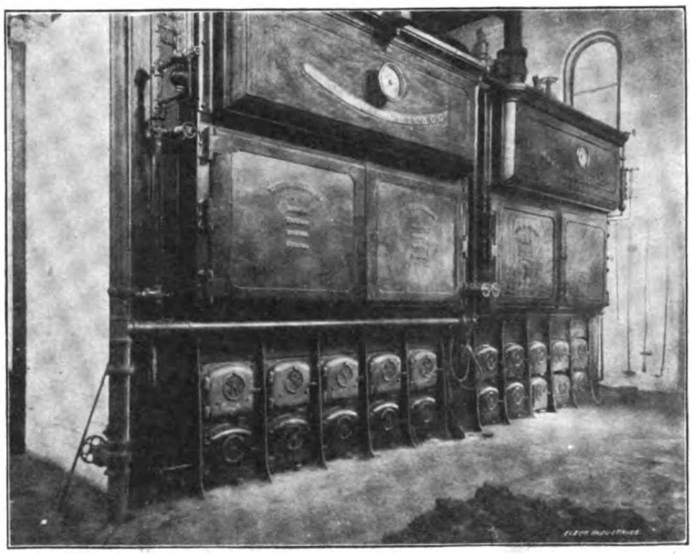


FIG. 4.—THE NEW ELECTRIC LIGHTING PLANT OF THE CITY OF CHICAGO.

The building has been well constructed, an excellent equipment purchased and installed. The arrangement does not, however, give the impression of an ideal plant. The method of transmitting and dividing the power involves an arrangement which demands a much larger space than that offered by the building erected for its accommodation. As it has been put in the entire space has been occupied. The jack shaft has been placed so close to the wall that a person can squeeze, if he is not too large, between the pulleys and the wall. On the other side the engines have been crowded to the wall. Access from without to the generators is only under the driving belt. The space for the dynamos is also very limited and allows barely room to pass between them. In fact, one's clothes would brush both machines, were they not held close to the body while passing between them. The only space available to turn around in was between the engines, but this has been filled with several pumps, the feed-water heater and their steam connections. There is a small space just within the line of belting for two more arc dynamos, the pulleys for which are in place on the shaft.

Nearly one-half the floor space of the engine room, however, remains vacant, but separated from the other part by the line of belting. This large space awaits a time when the city shall have funds that the city council will be willing to spend in the enlargement of the municipal lighting system for its equipment. The necessity of sufficient space in a power plant, and especially a plant of this kind, which serves so large a number, to render access easy to any part of the equipment and to facilitate repairs, should any be required, is generally recognized. This important factor and also the safety of attendants have been in a large measure overlooked.

Mr. F. B. Flynn is the chief engineer of this plant. He was formerly chief engineer of the Throop St. plant, and has been in the employ of the city for a long period. The building was designed by Adolph Finkler, city architect. The city has, with this plant, three plants located one in each of the divisions of the city as divided by the Chicago river. It is stated by those connected with these plants that could they be operated at their full capacity city lighting would cost much less per lamp than at present. To do this additional conduit and cables would have to be laid, and lamp posts and lamps erected for which there are not at present the funds available.

Franklin Leonard Pope.

Franklin Leonard Pope, an electrical expert and writer of world-wide reputation, was instantly killed by an electric shock on October 13th at his home in Great Barrington, Mass. He was connected with the Great Barrington Electric Light Company, and for the purpose of better observing the operation of the lighting system had a converter placed in the cellar of his residence. The primary to this converter carried a potential of 2,100 volts, and in some way not yet fully determined Mr. Pope received a shock from it which caused immedate death. His body was found beside the converter by members of his family. Aside from some slight marks on the back of the hand and fingers, there was no indication of the manner in which the shock was received.

Mr. Pope was born at Great Barrington on December 2, 1840. His early education was obtained at a district school, at the academy of his native town, and later at Amherst, Mass. An inclination was noticeable at an early age for drawing and studies of a scientific or mechanical nature. His first position was as a telegraph operator at Great Barrington, which he held for two years. An appointment as circuit manager of the lines on the Boston and Albany followed. As draughtsman in the patent bureau of the Scientific American and in various positions in connection with the telegraph systems of the country, an exploring tour in British Columbia and Alaska in connection with the overland telegraph scheme to Asia and Europe before a successful Atlantic cable had been laid, gave him a varied practical experience. His knowledge of patents was extensive, and, in connection with Mr. Thomas A. Edison, perfected the stock "ticker." Several of his inventions were purchased by the Gold & Stock Tel. Co.

He was well known as a patent expert, and was for a number of years so employed by the Western Union Telegraph Co. The introduction of the electric lighting systems drew his attention in that direction, and he established the firm of Pope, Edgecomb & Terry, patent solicitors and experts. About this time the opportunity that seem to open for an electrical paper was recognized, and he assisted in the publication of the Electrician, afterwards changed to the Electrical Engineer. He has since contributed to the various papers, and recently has had charge of a department in the Engineering Magazine.

Less than two years ago he returned to Great Barrington, his native place, withdrawing in a measure from active work. Being interested in the electric light station, he had conducted the remodeling of the plant, which was described in a paper read before the American Institute of Electrical Engineers. Friends from many distant cities assembled to pay their last respects to the dead on October 16th, on which date the funeral took place.

"Every section of your paper is interesting to a man in electrical pursuits." Jas. Quinne, Yreka (Cal.), Elec. Lt. Co.

The Alternating Current; Its Generation and Distribution.—X.

BY PROF. GEO. D. SHEPARDSON.

For distributing electrical energy by continuous current the circuits are arranged so that the lamps, motors and other devices for utilizing the energy, are in series or in parallel, as explained in the first paper (ELECTRICAL INDUSTRIES, October, 1894). When the lamps are in series, as is usual with arc lamps, the same current passes through all of them, one after the other, and the pressure or voltage necessary to be given by the dynamo depends upon the number of lamps in series. When the lamps are in parallel, or in multiple, each lamp receives its own current almost independently of the others; the total current delivered by the dynamo depends upon the number of lamps lighted; and the voltage is nearly constant. With the series system, it is practicable to reach comparatively great distances; but there are grave objections to introducing the necessarily high voltages into residences or other buildings where the lamps or wires may be accidentally or carelessly touched by persons or by grounded conductors.

As was explained in the first paper, the amount of territory that can be reached economically by the constant potential system with lamps connected in multiple is comparatively limited. Experience shows that with 110 or 125 volts at the dynamo, it is not economical to supply lamps much more than 1,000 feet from the dynamo. With 250 volts at the dynamo, using 220 volt lamps or the three wire system, it is found practicable to cover the territory within a radius of about one mile from the station. Experiments are being made in a few places to use 220 volts lamps on the three-wire system, thereby allowing a pressure of 440 or more volts between the outside wires. As reliable information concerning these plants is scarce, it is difficult to set the economical area to be served by such a system; but it would probably be within a radius of something less than three miles from the station.

Further difficulties with the continuous current constant potential system come from the common practice of tying everything together so as to form one circuit or net-work. The low voltage necessary with this system involves the use of large currents and therefore large conductors. Since large conductors are expensive, it is necessary to use them to the best possible advantage. The general practice therefore in central stations for supplying continuous current at constant potential, is to "tie" all of the feeders and mains together, so that they constitute a sort of network of wires, each positive wire being connected with other positive wires, and likewise the negatives being connected. By this it follows that if the load happens to be heavier in one place than at others, the current will come in from several different directions and no customer will be dependent upon a single feeder. By tying together the corresponding wires, the variations in the voltage at the lamps due to the "drop" on the lines are much reduced and the lights are of much more uniform brightness than if each district were entirely separated from its neighbors.

An example will illustrate the importance of keeping the voltage equalized in different parts by tying the mains together. It is common practice to calculate the feeders for ten or fifteen per cent drop at full load, the mains for one or two per cent and the house wires for two to five per cent. Suppose that one part of the circuit is fully loaded, while another part has most of the lamps turned off. The dynamo is adjusted to maintain standard voltage at the dynamo or more commonly at one or more main centers of distribution or points of important load. When one district is carrying a full load, the total drop in voltage between the lamps and the dynamo will be between thirteen and twenty-two per cent. Since the whole system is connected with the same dynamo, it will follow that if one part is fully loaded while another part is carrying only a light load, the voltage will be ten to twenty per cent lower in the loaded district than in the other. Therefore the lamps will be too dim in one place or too bright in the other. Another hour in the day the conditions might be exactly reversed. Now it is well understood that the life of a lamp is greatly shortened if it be subjected to too high voltage; and that, after being operated at high voltage for some time, its filament is so changed that it will not give full amount of light at normal voltage. It is therefore very desirable to maintain normal voltage at all lamps and not to allow any considerable variation. The only way to accomplish this result with continuous current constant potential systems is to tie the mains together so as to form a network, to feed in at a number of different points, to have most of the drop in the feeders and little in the mains. In some stations adjustable resistance boxes are connected in the feeders. Sometimes it is necessary to connect some of the feeders to auxiliary bus bars, which are kept at higher voltage than the main bus bars.

After having secured a network to give good equalization of voltage, there are at least two further difficulties to which attention is called by rivals of the system. In case of a break or cross caused by storm, fire, falling trees or other accident, the whole system is affected since all parts are tied together. If the different parts are connected by means of fusible connectors, these may (or may not) melt and cut loose the injured section before damage is caused by short circuiting and over-heating of the wires. Another and more serious difficulty is that if one side of the system becomes partially grounded, it affords a convenient discharge path for lightning and may cause damage by fire. If the circuit is grounded somewhere in the system, a small ground on the opposite side in another place may allow a greater or less leakage current which may char some carbonizable substance and finally set it fire. Even if the danger of fire is ignored, there is more or less personal inconvenience from handling grounded circuits, especially when working about a motor.

The above disadvantages of the continuous current systems are obviated more or less perfectly by the alternating system. At this point it should be noted that distribution at low and constant potential is not necessarily limited to continuous currents, as the alternating current may be distributed equally well in the same way, when there is any desire to use low voltage. The great advantage of the alternating current lies in the ease with which the energy may be changed from small current at high voltage to larger current at lower potential or vice versa. It is possible to change the energy of continuous currents also and this is done to some extent; but it requires the use of a motor and dynamo (sometimes combined in one machine with one or two armatures and called a "rotary transformer," (motor generator or "dynamotor") with the objections to having moving parts at high speed and the necessity for more or less skilled attendance.

By transmitting the energy at high potential, it is possible to use small currents and small wires. It is therefore economical and practical to reduce the drop on the feeders to two to five per cent, and thus avoid the necessity for tying different parts together. The common practice with alternating currents is to run separate and independent feeders to different parts of town or for different classes of customers; to use comparatively high potential (1,000 or 2,000 volts) on the feeders; to transform this down by stationary transformers to about 50 100 or 200 volts for the lighting mains. The lighting mains are thus entirely separate from and insulated from the high voltage circuits and also from other lighting mains. Each transformer also acts as a separate dynamo or source of supply for its district, so that the possible variations in voltage at any lamp are very much less than with the network system. The transformers of recent years are vastly superior to the older ones in point of regulation, efficiency and insulation. We shall next consider the transformer and its uses.

Meeting of A. I. E. E.

The American Institute of Electrical Engineers held the first meeting of the season on October 23. The New York members met at 12 West Thirty-first St., and the western members at the rooms of the Western Society of Engineers 1737 Monadnock block. A paper by Herman Lemp, jr., on "Local Annealing of Hard Faced Armor Plates," and one by Prof. W. M. Stine on "The Rating and Behavior of Fuse Wires," were read and discussed.

The Electric Railway up the Snaefell Mountain.

The electric railway recently completed between Laxey and the top of Snaefell, Isle of Man, has attracted considerable attention from English engineers. The road is about five miles long, double tracked, and rises over 1,800 feet. It reaches its upper terminus by an even grade of about 1 in 12, winding around the sides of the mountain. It has been constructed purely for the travel of summer visitors, and will be closed during a part of each year.

The construction of the road and its equipment differs but little from that of the ordinary electric road, and, although it is a continuous grade, no cogs are used. The emergency brake and third-rail system has been added as a matter of safety. This makes a great difference in the appearance of the track, and also in that of the cars. In Fig. 1 is shown a view of cars at terminal station, and Fig. 2 shows a view of a section of the line and the power house. This power station, strange as it seems, is located three miles from Laxey, on the side of the mountain, as shown. Its position on the line gives the shortest distance for the transmission of power, but the difficulty of conveying building material, the heavy machinery and fuel would seem to have overbalanced that advantage and caused the selection of a more easily accessible point. It was with great difficulty that the machinery was hauled to the power station by traction engines up a rough mountain road to a point above the station, from which they were let down the hillside.

The boilers are of the Lancashire type, giving steam at 130 pounds. The engines are compound and drive the 550 volt generators by link belting. There are in the station five of such units of 120 horse-power each. In addition to this equipment, there is at the lower terminus a battery of accumulators, consisting of 246 500-ampere hour cells. These are charged by the surplus current and discharge as the variations of load require.

The track is three feet six inches gauge, and is laid with fifty-pound steel rails. The center rail is constructed on what is called the Fell system, named from the designer. The rail is a double-headed sixty-five-pound rail, bolted to wrought steel chairs fastened to each tie. This rail serves the double purpose of preventing the cars jumping the track and as a continuous guide upon which the emergency brake may grip. Each car is fitted with two pairs of center guide-wheels, which run in a horizontal position. Each wheel is provided with flange to fit closely under the projecting head of the rail, which is thus locked on each side by two wheels, one pair being in front and the other at the rear truck. Any tendency of the car to leave the track is at once checked by these devices. In addition to the ordinary brakes, the driver has at his command the emergency brake, operated by a hand-wheel. This brake grips the center rail, and is able to bring the car to a stop in one car length when car is moving at its ordinary running speed. The track is bonded with copper strips riveted to the rails.

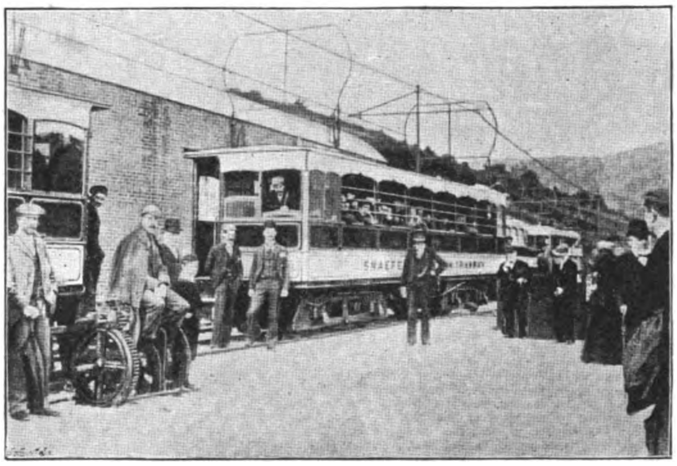


FIG. 1.—THE ELECTRIC RAILWAY UP THE SNAEFELL MOUNTAIN.

The overhead trolley system is used. The trolley wire, which is number 0 B.W.G. hard-drawn copper, is suspended 16 feet 4 inches above track from center poles. With the present traffic, feeders were not considered necessary, but as the travel increases feeders will be run to carry the current. The collecting device carried by each car is also noticeable. It is a broad wire frame with a horizontal length pressing against the trolley wire. The frame is fastened at the sides of car by spring connections, which permit its movement in the direction of car length. The length of horizontal section is sufficient to reach trolley wire at curves, etc. One of these collectors is placed at each end of car.

The car body is mounted on two four-wheel trucks. The car is vestibuled and has controller and brake handles in each vestibule. At the ends of line cars are switched from one track to another, the driver or motorman and conductor change positions, and the car is ready to resume its journey. Each car will accommodate fifty passengers. Upon each axle is mounted a 25 horse-power motor. The current consumed when running at the normal speed of nine miles per hour is 150 amperes. The power is sufficient to start the car at any point on the line. The road is now equipped with six of these cars.

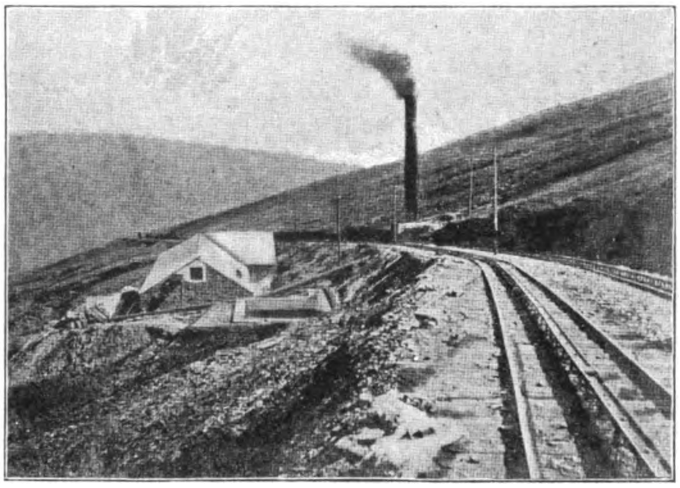


FIG. 2.—THE ELECTRIC RAILWAY UP THE SNAEFELL MOUNTAIN.

This railway has been constructed for excursion travel only, and its earnings during the season, it is expected, will be sufficient to fully cover fixed charges and operating expenses. Its cost is placed at about one hundred and fifty thousand dollars. The Douglas-Laxey line, which is dependent largely on the same class of travel, has proved very satisfactory as an in vestment to the stockholders. The completion of this line up the mountain will tend to increase the travel of the former, as the facilities for reaching these interesting points are increased. The illustrations are from the London Electrical Review.

Meeting of Ohio Electric Light Association.

The first annual meeting of the Ohio Electric Light Association was held at Piqua, Ohio, on October 8. The organization was perfected and such additions made to the preliminary draft of constitution and by-laws as were considered advisable. The constitution as originally drafted provided for active, associate and honorary members, but was changed to active and honorary. It was intended to allow manufacturers, supply dealers, etc., admission to the association as associate members, but under the revised constitution this is not allowed. Papers on interesting subjects were read and the various interests of the association discussed.

The officers elected for the year are: President, A. W. Field, Columbus; vice-president, Wm. C. Hedges, Mansfield; secretary and treasurer, Samuel Scovil, Cleveland, and the executive committee as follows: B. P. Holmes, Youngstown; H. K. Wood, Piqua, and L. C. Newson, Columbus.

"We are well pleased with your journal and our central station men prize it highly. W. E. McCully, Macon, Gas & Elec. Lt. Co.

Report of Committee on Patents.*

BY F. R. GREENE AND J. W. MCNAMARA.

Among the many perplexing problems that have demanded the attention of some of our western street railways is the question of "worthless patents," and it being evident to several gentlemen of the street railway fraternity that an association to handle all matters pertaining to patents, as affecting street railways, would be highly beneficial to all concerned, a committee was appointed at Atlanta to take up the matter and submit a plan of organization.

This committee, working upon the lines suggested, has investigated the matter as far as it has been within their power, looking up facts and matters pertaining thereto, and desire to submit to you the following report for your careful consideration.

The majority of street railways have, at one time or another in their history, been sued for using or making some device which was an alleged infringement on some patent. These cases were either fought out in the courts, or settled by the railway company rather than go to the expense of court costs and attorney's fees. A large proportion of railways have paid and are now paying royalties, either directly to the patentee or indirectly to the manufacturer (the royalty in the latter case being included in the price of the article paid by the purchaser), on certain articles in use on their systems. These direct royalties are often paid when exacted to avoid going to the expense of hiring an attorney to look up the patent papers to see if the claimant has a good patent and a valid claim to his royalty. The writer knows this to be the case with the company with which he is connected. The expense of investigating such matters is often more than the amount involved; hence the matter is settled upon the payment of a few hundred dollars. The manufacturer should stand the burden of infringement suits, and not the purchaser, and the advantage of an association of this kind would be to influence or compel the claimant to direct his suits against the manufacturer and not the railways. Since the adoption of electricity as a motive power, we find that the number of patented articles in use on street railways has increased wonderfully. We are confident that a large number of these patents are worthless and will not "hold water."

Were these alleged patents to be investigated, a great number would become common property on account of the patent feature becoming eliminated, and hence the patentee would be deprived of his royalty, and the manufacturer would at once reduce his price in consequence. We do not mean to say that the honest inventor is not entitled to his royalty, provided he has a good, bona fide invention. It is clearly evident that if the street railway companies were combined together in an association of this character, the expense to each would be small, while the advantages will be manifold. Another important item will be the assistance of the association in advising its members concerning new inventions of their own employes, whether said articles are patentable, or whether infringements on other inventions, said assistance to be furnished free to said railway companies, which are members of the association. This will serve to encourage employes to work out improvements in devices in use on street railways and protect them in their rights. The advantage to the company presenting such new invention will be that they will be permitted to use said device free of royalty.

A great many devices in use on our system are common property at the present time from the fact that the patent has expired, yet how many members of this association know the expiration of the patent limit on a single device in use on their road, and, in ignorance of such facts, are still paying the same old price.

The idea of such an organization of this kind was prompted by the fact that two similar ones have been in existence for over twenty-four years for the benefit of the steam railroads, and have been highly successful in every detail. One of these associations is located in the east and the other is located at Chicago, and the two include as members all the important railroads in the country and a large number of the smaller roads.

The object of the Western Railroad Association, as stated in its by-laws (from which I quote), is as follows: "The object of this association is the investigation of all patents and improvements affecting the interests of railroad companies, members hereof, and their mutual protection against the unjust and unreasonable claims and demands of patentees and their representatives, and the procuring of other information which may appear to be of value to the association."

We have had several conferences with the general counsel of this association, and he has been very kind in giving us information regarding the working of his association. He also declared that an association of like nature for street railways will be highly beneficial to all concerned, and recommended it. I have with me a copy of their constitution and by-laws, also a copy of their annual report for the year 1894, which is worthy of inspection and a valuable guide to the street railway interests.

This association is maintained by an annual assessment of its members based on the gross earnings of the several railroads, payable in quarterly instalments. The expenses of the association consist of the salary of an attorney, office help, rent, traveling expenses, court expenses, patent office books, pamphlets, etc., and is conducted on a more expensive scale than would be necessary in a like organization for street railways. For instance, in the beginning our association might not feel like hiring an attorney to give his entire time, but only pay him for actual work, on fixed rates. The expenses for the first year would, of course, be larger in proportion than the following.

The Western Railroad Association has won four-fifths about, of their suits, and stands all expenses connected with said suits, but does not, of course, pay any judgments; the defendant road paying any judgment that may be entered against them. The entire membership, however, obtains the benefit of all such trials. The work performed by the Western Railroad Association in 1894, if done through the regular channels by the roads themselves, would have cost about ten times as much as was paid to the Association during the year for same. It is the practice of the roads belonging to the association not to put on any new device without first referring same to the association for advice. The number of suits against the railroads have been reduced very materially since this association was started, and $60,000,000 in judgments were defeated in one year. One of the large trunk lines paid $10,000 for using a patented article that was afterwards found to be worthless so far as the patent feature was concerned. Since then they refer all such matters to the Western Railroad Association before adopting devices or settling claims of this character.

A certain street railway, so we are informed, paid $1,500 to prevent suit on an alleged infringement, and the patent was worthless, as was afterwards learned; this might have been saved if an organization of this kind was in existence.

One of the roads represented at this convention is negotiating at the present time with two different firms on matters that could properly be referred to an association of this character. One of the articles in question is used by all electric railways in large quantities, and the inventor is receiving large royalties from the manufacturer. A patent attorney informed the road that he thought the patent worthless, but it would take a law suit to convince the manufacturer. If this be true, this road would have saved ten to fifteen thousand dollars by having this matter investigated at the start, saying nothing about what others would have saved that are using this article today and are paying the manufacturer whatever he chooses to ask.

The other device referred to can be manufactured by the companies themselves, which is also true of the former article, and has recently come into use and is being used by several companies in large quantities. The patentee is willing that the street car companies manufacture said devices themselves, providing they will pay him a large sum of money for the privilege of so doing—the company already having paid him many thousands of dollars for furnishing said articles up to this time. We understand that a similar device has been used by another manufacturer in the past, though for some reason it was not patented. This being true, the patent is worthless, and his demand for royalty would fall flat were the same taken to the courts for settlement. These two matters are still unsettled and are very important to the roads in question, as well as to others who are members of this association and are using the same device.

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*Abstract of report of committee at Montreal meeting of the American Street Railway Association.

Another road, a few years ago, paid over $1,000 in royalties on a truck that was invented by a former employe while working for the road, simply to prevent a law suit, as it would cost more than this amount to have defended the suit. Other cases could be mentioned, but I will not take up your valuable time.

Another important feature in this connection would be the collecting of different patented devices in use of our system, the same to be preserved and open to the inspection at all times of the members of the association. In short, we might sum up the most important points. as follows:

1. Lessening total expenses in fighting patent suits, etc., as a suit affecting one road would affect all.
2. Uniformity of action.
3. Additional safety in putting on new devices.
4. Greater facility in defending suits, etc.
5. Decrease in number of suits and claims on account of the existence of such an association.
6. Advantage in settling suits.
7. Contending and avoiding unfair and unjust royalties.
8. Reduction of prices on all patented articles.
9. By members refusing to buy articles where suits are brought against any of its members, thus shifting suits to the manufacturer.
10. The dissemination of valuable information to its members of all matters relative to any suit, etc., in which one or more members are the interested parties.
11. Advantage of employes of street railway companies in getting valuable information and assistance on their own inventions, whether patentable or infringement of other devices, without cost to said railway or employe.
12. The acquiring of a full and authentic report of all devices that are commonly found in use on all street railways, such as fare registers, brakes, rail bonds and numerous other articles, giving the expiration of all such patents, opinion on the validity of same, etc., and to be followed up by like reports from time to time, giving lists and opinion of new patents, and lists of expired patents.
13. The acquiring of models, devices, etc., for permanent exhibition.

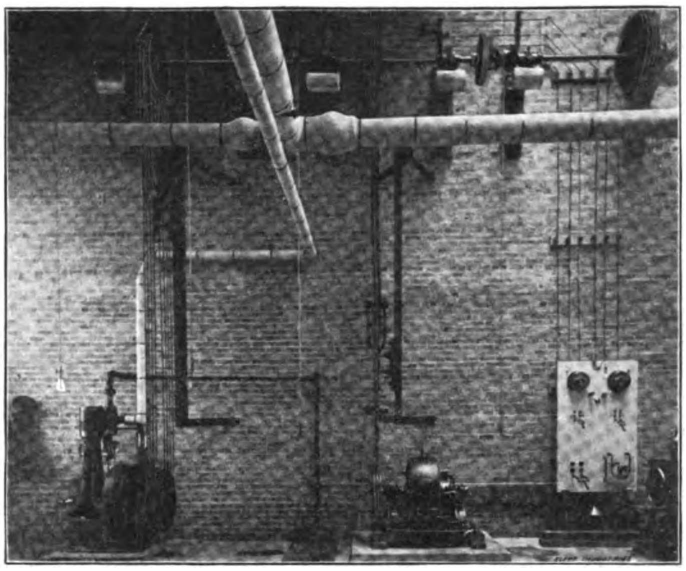
Some Features of an Isolated Lighting Plant.

At the new malt house and elevator of Albert Schwill & Co., South Chicago, a small isolated lighting plant does most efficient service. It is used not only for interior lighting, but also furnishes arc lights at the railroad switches and in the yards. The accompanying illustration gives a view of the plant which was recently installed in connection with the power plant. The engine room is large and well lighted, the main engines are in duplicate and transmit their power through rope drives to a line shaft from which the different elevator and conveying systems obtain their power.

At the north end of the room is located the dynamo, switchboard, etc. Above the dynamo is a line shaft at the same height as the main shaft driven by the large engine. The two are connected by a rope system, and the pulleys are fitted with clutches. To this shaft there is connected by the same system of rope drive a Racine automatic vertical engine, built by the Racine Hardware Co., of Racine, Wis. This method of connection enables the dynamo to be run by the large engines when running, and during the remaining hours of the day or night by the smaller engine. The shifting of the clutch cuts the smaller shaft off or on to the larger. The arrangement of the shafts and rope drives of both this and the other part of the power plant is such that the floor space is free from all obstructions, the rope drives being near the ceiling or walls. Every part of the engines are accessible, and when occasion demands there is nothing to prevent any point being quickly reached. A smooth cement floor, large skylight and well arranged equipment makes a very neat looking engine room.

The engine is of a kind used to a considerable extent for the operation of electric dynamos and generators, sometimes belted, at others direct connected to multipolar machines. It regulates very closely, an important feature usually, but in this plant the number of lamps burned does not vary sufficiently to make a perceptible difference in the load. It is mounted on a heavy, well proportioned base. The slides for the cross-head are cast solid in the frame, as are also the broad boxes for the shaft. The connecting rod is from a steel forging. Shaft, crank and crank pin are made from one piece. The bearings and moving surfaces are provided with self-oiling devices. The valves are well balanced and the governor of an improved type. This engine was installed from the Chicago office of the company.

The electrical equipment, although not large in size, has been selected and installed with the greatest care. The generating plant consists of a Triumph dynamo of 15-kilowatts capacity, built by the Triumph Electric Co., of Cincinnati, Ohio with regulating devices mounted on a very neat white marble switchboard. This dynamo is of a new type of multipolar machine, but comparatively recently placed on the market. It is well proportioned with broad base and the center of gravity low down. Its outlines are neat and have every evidence of skill in the design and construction. Since being installed, it has run very smoothly to the perfect satisfaction of the owners and those in charge. The switchboard is made up of a single large slab of white Tennessee marble, mounted on an iron frame. It contains voltmeter, ammeter, rheostat and dynamo and feeder switches. The leads from the generator run along the wall the short distance to the board, and the mains rise directly above the board where they separate, some going in one direction and some in another.



SOME FEATURES OF AN ISOLATED LIGHTING PLANT.

The lighting required of the plant includes both arc and incandescent lights. For the interior incandescent lights are used both in the malt house and the elevator adjoining. Since cars are being switched from the railway lines passing the elevator at all times of the night, lights are necessary about the switches and yards. At points conveniently located arc lights are placed, suspended from brackets on poles, the wires from the plant are run on poles of a sufficient height to place them out of reach of either cars or trainmen. These lights are also of advantage as a police protection since the buildings are in a thinly settled part of the city. The plant is complete in every respect and might well be visited by anyone interested in the subject since it shows the simplicity with which the different kinds of electric lights are obtained from one generator and the ease with which both street lighting and interior lighting is done.

"I am very much interested in the paper." Hermon Hunt, Oskaloosa (Ia.), Gas Co.

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To unwrap your paper, pull out the string which you will find in the wrapper.

Since the first practical application of electricity patent litigation has been a conspicuous companion. First the telegraph, then the telephone, the incandescent lamp and the thousands of auxiliary devices used in the application of the various systems of lighting and power have been covered by patents the validity of which has required millions of dollars to establish and defend. These fundamental patents have been expiring one by one but the end is not yet. Patents covering recent inventions in power and lighting systems are now in dispute. Another struggle is necessary to determine the validity of these patents. It will not only be fought in America but suits recently instituted in the chief commercial nations of the old world indicate that the strife has extended to these countries.

It is strange indeed that one who had attained so high a reputation through long service and worthy attainments should at last fall a victim to what had been the subject of his life's labors. Such, however, is the uncertainty and peculiarity of this life, and in the life and death of Franklin L. Pope, whose death is announced in another column, there is both an example and a warning. His work in connection with the electrical industries was characterized by an intelligence and a perseverance that soon won for him a position as an expert and engineer; his writings on electrical subjects greatly extended his acquaintance and his pleasant genial manner won him many warm friends. The announcement of his death as chronicled in the daily press was read with universal sorrow by the many who knew him either personally or by reputation.

The convention of the American Street Railway Association, held last month at Montreal, was most successful, not so much for the immediate results as in the future benefits which are promised from the new interest aroused in the work of the association. The papers read and discussed were few in number, due to several causes, but the time was well spent in the general discussion of the needs and work of the association. Although final action was not taken on several important matters, they are unquestionably in good hands, and the result will be more satisfactory for having received greater study during the coming year. The association, it is hoped, has escaped from the rut in which it has been running, and enters upon a more aggressive period. A departure from old customs was noticeable in many instances, and especially in the selection of officers and committees. The effort made to clear the association from the debt that has hung over it and impeded its action is noteworthy, and the prompt response of members when the matter was presented to them is commendable.

The papers read at the convention, while not numerous, which is to be regretted, were all of particular interest. Since a majority of railway companies manufacture to a greater or less extent their own supplies, the subject of patents must necessarily be frequently considered, and the report of the committee on patents suggests a movement in the right direction. A standing committee, which would take up the matter in a systematic manner, could soon gather a large amount of data respecting the patents on street railway appliances. These records would be open to the members of the association, who would on such a co-operative plan secure at small expense what now causes them great inconvenience and expense. Information now possessed by the individual companies could be contributed for the benefit of the other members of the association. The paper on ties and poles, by Mr. N. W. Brown, presents a considerable information on the life, cost and durability of the different kinds of ties and poles. The subjects of air brakes and the heating of cars were well presented. The cost of the different systems of car heating was carefully computed from data obtained from several roads. The construction of heaters and the distribution of the heat in the cars were points carefully considered.

The resistance of the return circuit of the early electric railway systems consumed a large amount of power. It was not only a heavy drain on the power plant but the current in returning to the generator jumped from track to water or gas pipe or any other metallic body that would assist it in its return. These lines were not only expensive to operate but caused a rapid deterioration of underground pipes. The proper construction of the return circuit has therefore received special attention on all recently constructed railways and just in proportion to the improvement in the provision for the return of the current to the power-house has the deterioration of underground pipes through electrolysis been prevented. The connection of the rails to the systems of gas or water distribution has also been found to prevent the electrolytic destruction of the pipes. This evil although still existing to a certain extent is largely guarded against.

The rails afford ample capacity for the current return except at the joints and to provide suitable connection at these points numerous expediences are employed. The fish plates of whatever length are found insufficient since contact is poor and resistance increases by both loosening and dirt working between the plates and rail. Therefore copper bonds have been for several years employed to decrease the resistance of the joints and to make as near as possible a continuous metallic conductor. There are upon the market several styles of rail bonds which have been adopted as the standard on different railway systems. These may be divided into two general classes, the bolted bond and riveted bond, each of which have their champions. The aim of each is the same, the method of accomplishing it alone being different. The bond is intended to have a carrying capacity equal to the power employed on that division and to have a connection with the rail equal in extent.

The welding of the rails has been successfully accomplished by two different methods during the past year or two. This method secures a continuous conductor the entire length of the line with a capacity throughout its length equal to the capacity of the rail. The variations in temperature contrary to what might be expected do not affect the track, which being buried in the pavement is not subject to so rapid changes of temperature. The first method of welding employed was by the electric welding process under the Thopson patents; the second is by a cast welding process previously described in this journal. The constructing engineer and railway manager have these different methods of providing a return circuit to select from. Each has had a sufficient trial to discover any defects or disadvantages. This has been one of the weakest parts of the overhead trolley system but it has received such attention as to bring it up to the standard. Contrary to the claims of many the overhead trolley will continue the prevailing method of constructing electric railway systems. It is the simplest, least expensive and most reliable system. The advocates of the underground trolley have yet to prove the advantages of that system in all climates and conditions. It is a fair weather road but it has not as yet proven its serviceability in a northern winter nor during spring freshets.

The effort made by the committee appointed by the National Electric Light Association to secure the adoption of one standard set of rules for the installation and operation of electric plants is to be commended, and the assistance of all interested should be given to bring about the end desired. At the present time the different associations have sets of rules, the boards of fire underwriters have their rules, some of the cities have a set of rules, causing confusion, inconvenience and a great deal of poor work. It will require time and hard work to secure the consent of the different bodies to co-operate in the formation and adoption of a standard set of rules for all, but when once accomplished it will be a benefit to everyone, and the labor will be well repaid. The formation of the joint committee will bring the subject before each organization, and will awaken an interest in the movement. The various rules and tables now compiled contain good points, but no matter how well a set of rules might be made up, if the terms, phrases and rules contained therein were not generally recognized and accepted the compilation would benefit but a few.

The industry has gradually acquired a phraseology, but much of it is still ambiguous. The various standards of measurement have received a great amount of attention, and, as adopted by the international congresses, are universally accepted, but they are exceedingly exact and are too small for every day use. The terms of the mechanical engineer have been necessarily used, but these in many cases are meaningless terms and only approximately accurate. The capacity and efficiency of electrical machinery is easily determined; electric power is easily measured, and with great accuracy electrical measurements, could, therefore, afford a better standard of comparison than the terms so long in use. Terms, like "horse power," are first confusing since the name gives no indication of the value, and is applied in several different ways, so that the words convey no definite meaning. Electricity is the form in which energy is most readily handled, and the terms adopted in connection with it will undoubtedly be the most lasting.

Recent tests and experiments on the Erie canal looking toward a more economical method of propelling canal boats, if reports are true, will probably result in a revival of this method of transportation which has been for some years considered almost out of date. A few decades ago the Erie canal was looked upon as one of the greatest systems of transportation, but while its tonnage for the season is large in the grain, coal, ore and lumber trades the percentage of the total amount of freight carried between Buffalo and Albany is small. This percentage is gradually decreasing, and unless some method of improving this slow-going transportation system is found appropriations from the state, which for some time have required great pressure to get through, will cease and the Erie canal will become as the other canals of the state have become, the line of a railroad or a part of the grazing land of adjoining farms. The tests made two years ago proved little; any engineer knew as well before the trial as he did after that if an electric motor were connected to the propeller shaft and supplied with current that it would turn it as well as a steam engine of the same capacity.

Recently a system invented by Mr. Richard Lamb and applied successfully in conveying logs through the timber districts and for similar purposes, has been tried and reported as fully up to expectations. As adapted to the canal boat the system is constructed in very much the same manner as in conveying logs, except that the boat is drawn through the water instead of being suspended in the air. For the purposes of this test a row of posts was erected along the bank of the canal, on which heavy iron brackets were fastened. On these brackets insulated saddles were placed, as the electric current is cenveyed through the upper cable. A lower or traction cable is suspended below from a separate set of brackets. The upper brackets carried an inch and a quarter cable and the lower a five-eighths inch cable. The motor truck, with deep grooved wheels, is suspended from the upper cable. This truck carries a 15 kilowatt motor turning a grooved sheave around which the five-eighth inch cable is wound three times to give sufficient tractional friction, the driving cable being securely fastened. The current is carried by the upper cable and returns through the lower and the ground.

It is estimated that the cost of carrying freight by this method from Buffalo to Albany will be about one-half the cost by the steam roads and about one-fifth that of the present method of mule power. If these claims can be substantiated electric power has scored another point and the canal mule will be a thing of the past. Future statesmen and presidents will sit on the deck and work the controller handle instead of following the tow path behind the mules. These tests, however, offer but a small amount of information upon which to make an estimate of the actual cost in practical operation. The speed of the canal boats is stated at three miles an hour, which limits the use of the canal to a few kinds of freight. The adoption of any improved form of haulage is probably conditioned upon the appropriation by the New York legislature of a sufficient number of million dollars to repair and deepen the canal.

The Electrical Development of the Falls of the Willamette.

Several plants now in operation demonstrate the practical nature of the long distance electric power transmission systems. The loss in transmission is so small in comparison with the gain from this form of power that as business enterprises such systems are clearly successful. There are a number of such enterprises now under way but among those nearing completion the plant at Oregon City, Ore., on the Willamette river for supplying Portland and suburbs twelve miles away is of particular interest.

The enterprise was undertaken by the Portland General Electric Co., which secured the water rights together with considerable real estate adjoining the falls. The power derived from the falls is not all for transmission to Portland, but a large part, it is expected will be used by manufacturers at Oregon City. The total power of the fall is estimated at 50,000 horse-power. The completed plant will develop one fourth of that amount or 12,500 horse-power. The plans of the power house show twenty sections, five of which have now been erected and foundations for the balance are in. The building is of durable construction, stone, iron and concrete being used. The equipment will be increased as customers are found for the power. The first part of plant furnishes power for street railway systems, for lighting systems and a number of manufacturing plants.

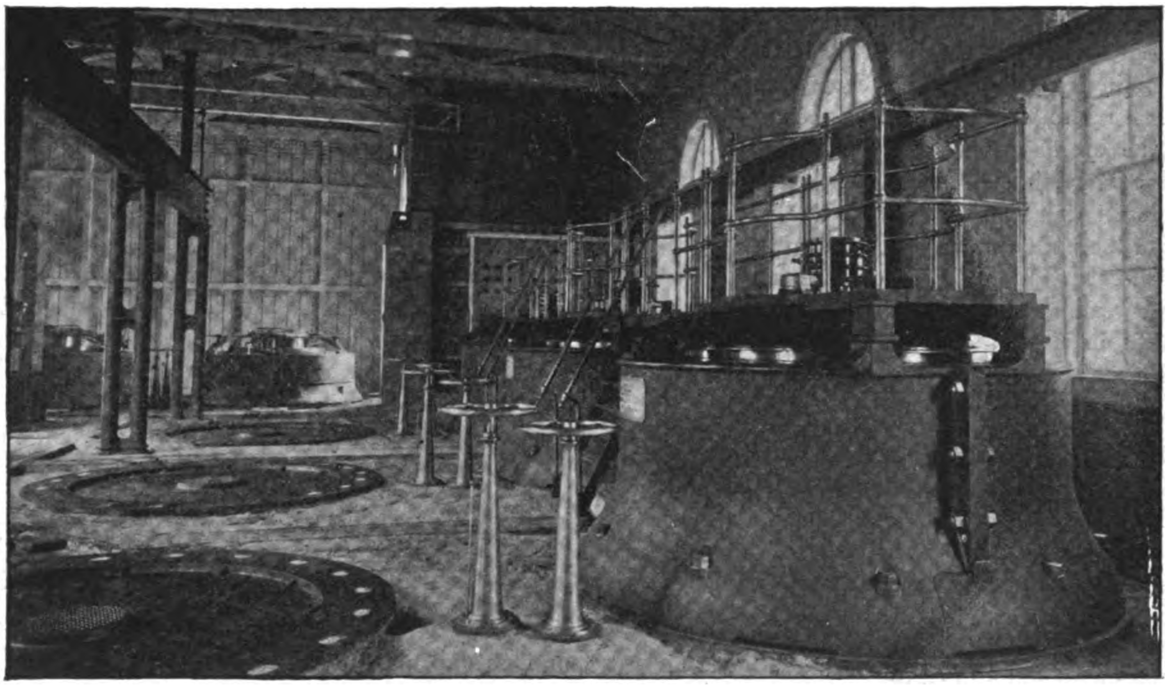

FIG. 1.—INTERIOR OF STATION, SHOWING THREE 3-PHASE GENERATORS AND TWO D. C. EXCITERS.

The water wheel plant is from the works of the Stillwell-Bierce & Smith-Vaile Co. of Dayton, O., and consists at the present time of three units, each consisting of a pair of vertical cylinder gate improved Victor turbine wheels, 42 inches and 60 inches in diameter respectively. The larger wheel is an auxiliary to be brought into service only at periods of excessive high water, which the records show occur about once in every five years. The smaller wheel runs at a speed of 200 revolutions per minute and the larger at 100 revolutions per minute. Both turbines are set at the same level and each carries a pulley; that of the 60 inch wheel being fixed to the generator shaft. When the large wheel is in operation the two pulleys are belted together, the smaller wheel is disconnected and the large wheel drives the generator at a uniform speed of 200 revolutions. When the smaller turbine is operated alone the belt lies upon a shelf surrounding the pulleys.

The weight of the vertical shaft with the armature is about 33,500 pounds and to carry this a system of extra bearings is introduced, one of the ring thrust type and the other a hydraulic oil bearing, both supplementing the ring bearings on the armature shaft. They are enclosed in cases filled with oil delivered by hydraulic pressure, and are surrounded by water jackets.

The length of the generator shaft is 29 feet, and 8⅜ inches in diameter. It is not a continuation of the shaft of the wheel but is coupled to it by means of a disc coupling, which allows of a certain free movement up and down of the generator shaft. The shaft of the 60 inch wheel runs from the coupling to a bearing set in the floor of the station. Both wheels in each section are controlled by hand wheels and both are regulated by the same governor. The belt tightener is also controlled from either floor by a hand wheel.

The water is admitted to the penstocks from the upper canal by means of a head gate operated from a platform on the canal side of the station. Each penstock is ten feet in diameter and is constructed of riveted steel plates. Each wheel has its own flume, the water passing first through the large flume of the larger wheel to the flume of the smaller wheel, whence it passes through a tube into the tail race. In addition to this turbine equipment, an auxiliary power equipment has been furnished, consisting of a set of pumps, including a hydraulic pump for supplying oil to the thrust bearing cylinders and a duplex water pump to circulate the water in the cylinder water jackets. They are operated by two 15-inch horizontal turbines enclosed in the same flume.

For the operation of the exciters a further pair of vertical turbine wheels has been installed, each 48 inches in diameter, driving the generators by a similar system to that already described for the operation of the main machines.

The five sections of the building already erected are occupied in the following order. The first section contains the pumps and the accumulators for the complete station; in each of the three following sections is one three phase alternating current generator of 450 kilowatt or 600 horse-power capacity, and the fifth section contains two 250 kilowatt multipolar continuous current generators used as exciters. Each exciter is capable of exciting all of the twenty, three-phase generators, and the second has been set up as a reserve in case of accident to the first. At present, one is furnishing direct current to the street railroads in Oregon City. When the station is complete, the exciter section will be removed from the fifth section, which it occupies at present, and will be placed in the centre section of the building, where the switchboards will also be erected.

The generators are of special design and are set upon the floor of the station, the armatures revolving in a horizontal plane, with one bearing at the floor line and another on top of the armature underneath the collector rings. Each generator has twenty laminated poles. The armatures are a little over seven feet in diameter and are about two feet high. These armatures are constructed to deliver current directly to the line at a working potential of 6000 volts effective pressure without the intermediation of step-up transformers. On account of this high voltage unusual precautions were necessary to perfect the insulation of the armature coils to avoid leakage to the ground. The armatures are wound with flat wire and each of the coils is divided into sections, each section being separately insulated.

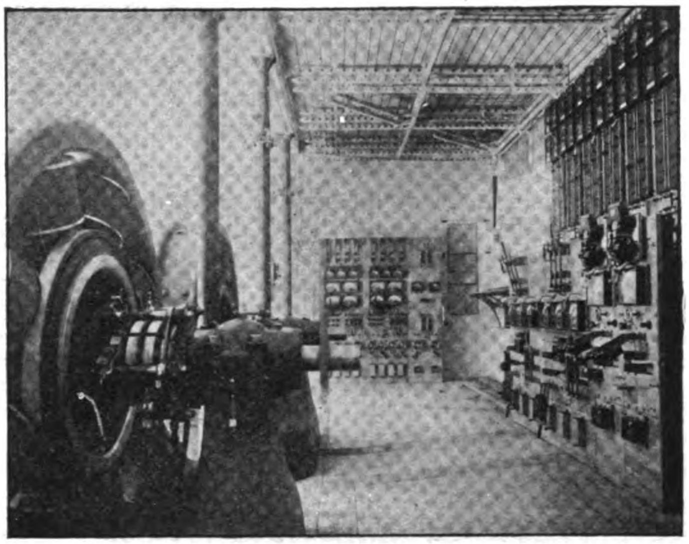

FIG. 2.—3-PHASE OR RECEIVING SIDE OF ROTARY CONVERTERS.

From the generators the current passes directly to the line through the switchboard. The line is 14.3 miles long, a separate circuit being installed for each machine. It passes through an undulating country following the course of the Willamette river as closely as possible. The poles upon which the three phase wires are strung also carry a number of wires for the 5,000 volt continuous arc current from the old transmission station, as well as the wires over which the old system of lighting with high frequency 5,000 volt alternating current is effected. The loss in the long distance transmission line is calculated at full load at about 11 per cent.

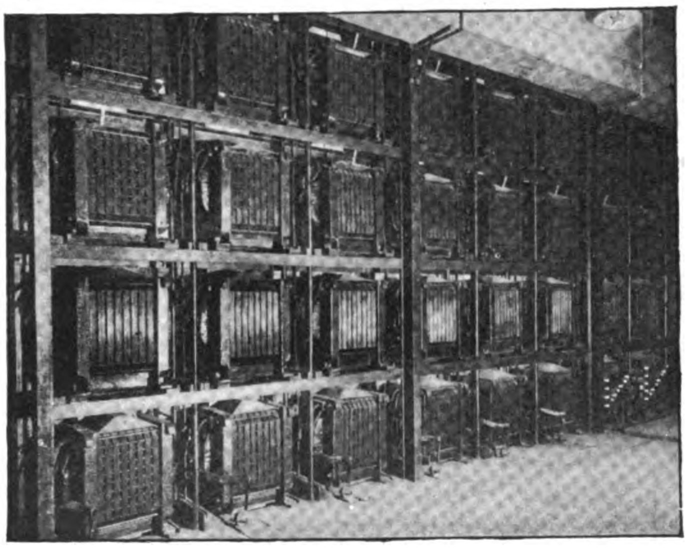

FIG. 3—THE REDUCING TRANSFORMERS.

The sub-station to which the high frequency lines are brought, is a two story building at the corner of Seventh and Alder streets, covering a space of 40 feet by 100 feet. The lower floor is divided into three rooms, one containing the transformers, the second the rotary converters, the other being used for a repair shop, lamp and meter room. The upper story of the building is occupied by the offices. In the transformation room at present are the necessary transformers for the three units already installed—45 transformers in all. The receiving end of each line is connected to a bank of 15 transformers per generator, five being placed between each pair of wires of the three-phase system. The transformers are mounted on an iron rack five transformers high and three wide and foundations are already laid for six additional units. Each set of five transformers is connected in the primaries in series and to the secondaries in parallel, although in the transformation of the three phase current two sets only are necessary. The distribution of light from the secondaries is effected on the Edison four wire system which allows of a large territory being operated from one transformer station and which also allows of the working of synchronous and induction motors from the lighting mains. The four wire system is worked at 1,000 volts between wires. The direct current for the railway service is obtained by conversion from the three-phase alternating current. This is effected by means of rotary transformers. Two of these are at present installed in the sub-station and space has been left for an additional three. The capacity of each converter is 500 horse-power delivered to the bus bars of the continuous current switchboard.

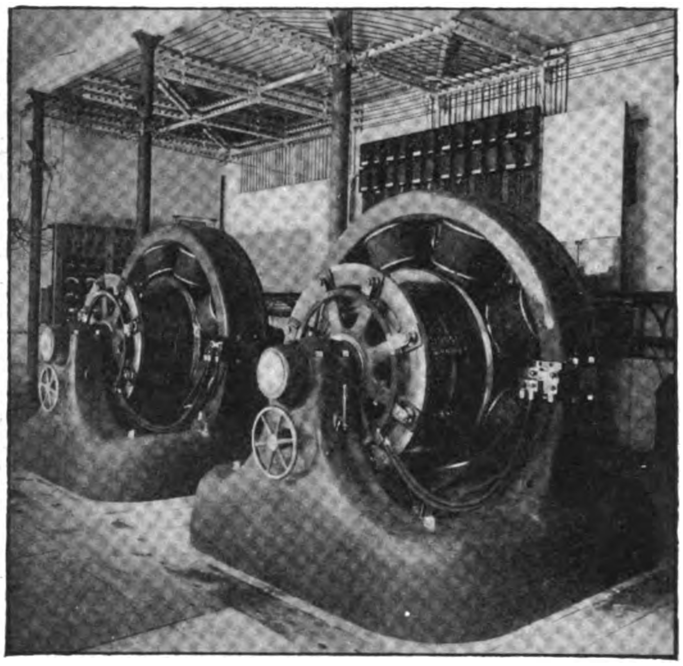

FIG. 4.—DIRECT CURRENT SIDE OF ROTARY CONVERTERS.

The long distance transmission lines, for this railway service, as in the case of the lighting circuits, are connected to step-down transformers, transforming the current from 6000 volts on the line to 400 volts at the secondaries. The secondaries are connected to the three collector rings on one side, and the current is thus brought into the armature of the rotary converter. The alternating current at 400 volts is then converted into this machine into direct current at 500 vots. Each rotary converter has a capacity of 400 kilowatts. They are eight pole machines making 500 revolutions. The armature is iron clad, carrying at one side a commutator and at the other three collector rings.

Statue of Benj. Franklin for a Chicago Park.

Mr. Joseph Medill, editor and publisher of the Chicago Tribune, has tendered to the Lincoln Park commissioners a bronze statue of Franklin, who is considered by the donor one of three or four greatest men our country has produced. The statue will be of bronze on a granite pedestal, and will be as faithful a reproduction in feature and form as the best talent can make it. While all the details have not been worked out, it is expected that it will cost about $20,000. A clay model, nine feet high, of the proposed statue is now in the studio of Richard H Park. The entire expense of statue, pedistal, and setting is borne by the donor.

Practical Electrical Testing.

BY C. C. HASKINS.

To know how to make a test or a measurement of capacity, insulation, resistance and conductivity is a necessity for the constructor and the dynamo man, and if not a necessity to a lineman or the bell-hanger, it is at least a great convenience to know how, should occasion demand.

There are many simple methods of making the various tests, such as are required in house circuits for bell systems. The most common instrument is the magneto bell, which is but a very small alternate current dynamo. The magnet is stationary, the spools revolving across its field represent the armature, and as there is no commutator, the current generated is changed constantly from positive to negative and back again.

This instrument, while good for bell work, is faulty for testing for anything requiring more accuracy than what is necessary in finding a cross or a dead ground, or selecting wires which are grouped. Its advantages are its ready application, its cleanliness, and the fact that it never needs renewing like a battery, and rough usage is not liable to do it harm.

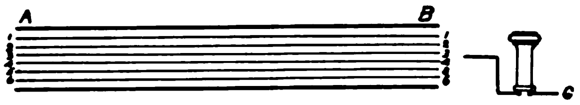

FIG. 1.

Its disadvantages are its clumsy, heavy ungainliness, and the fact before alluded to, its alternate impulses, which unfit it for some kinds of testing. A couple of cells of dry battery with a vibrating bell is often used in the same kind of work. A cheap form of telephone may often be used to advantage in connection with a very small amount of battery, particularly in the selection of cable wires.

Let us suppose that Fig. 1 represents a cable with six wires, and it is desired to tag these, so that any one or any pair of these may be used in the future. If a party at A, with a magneto or a battery, one pole of which is grounded, attaches the other to a wire, say No. 1, and turns the handle or closes the battery through a vibrating bell, there will be no response while the opposite end of that wire is open. But immediately the party at B touches the wire No. 1, a circuit is formed through the telephone to ground, and the party listening will now hear the vibrating bell, and be enabled to tag the wire.

Two very simple galvanometers placed at the extremes of the cable, the battery being arranged as before, will answer the same purpose. Whenever B closes the circuit by touching the wire which is connected at A, both needles will be deflected.

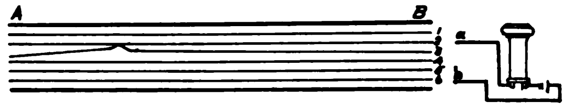

FIG. 2.

A cross in the cable may be found by making the test at one of its extremes. Wires 2 and 3 are crossed in the cable. Of course it is necessary to "kill" these two conductors, or use them as one. Now, with A joined to 1, touching the other 4 wires would produce no result. Now try 2 in the same manner. With A attached to 1 and B in contact with 2 a perfect circuit would be formed, and the telephone would respond.

So far, we have done no measuring proper; we have only tested for continuity. We have formed metallic circuits when we have sought pairs of wires, and used the ground return when testing out single conductors.

To measure for any purpose implies more than ascertaining that a fact exists, and a second factor enters into the problem—quantity.

If we test for resistance, for insulation, for capacity, we require some method by which we can know how much of either of these various characteristics we find.

Let us take the first mentioned, namely, resistance. We will say we have a coil of insulated wire which we desire to measure the resistance of.

While other methods have been repeatedly suggested, the use of a galvanometer in some one of several combinations is necessary. The principle of the galvanometer is always the same, the deflection of a magnetic needle lying in the earth's magnetic meridian, by the action of a current of electricity sent around it in the line of that meridian; or in other words, if a current of electricity be made to circulate through a coil of one or more turns, over and under a balanced needle lying in the north and south direction, that needle will tend to place itself at right angles to its normal north and south position; and if the current flows in one direction around it the deflection will be easterly, while, if it flows in the other direction around the needle, the needle will be deflected westerly. Fig. 2 will readily explain this. Let A B represent a coil of several turns of insulated wire, one terminal attached to the battery and top of the key, the other to the anvil. When the key is open, the coil being in a north and south position, the needle N. S. will rest in the same direction. Now, if we close the key K, a circulation of current sets up a magnetic field, and the needle will be deflected by the action of that magnetic force, and the tendency of the N end of the needle to point east or west can be remembered by what is known as Ampere's little man, who lies above the needle, and facing it. Now, whether under or over the needle, provided he is facing it, a current of electricity flowing from south to north—from his feet to his head—will always deflect the needle in the direction of his left hand. For when he is facing the needle from above his left will be west, and when facing it from below, the left will be east.

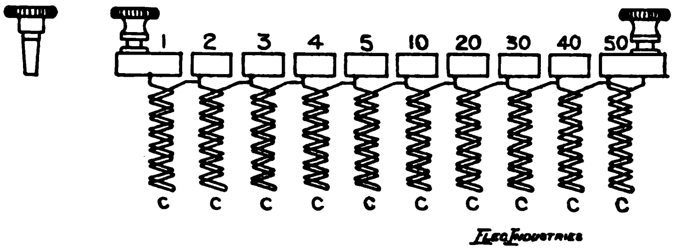

FIG. 3.

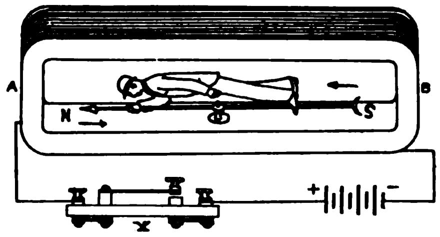

FIG. 4.

Suppose, now, we have a box of resistances, which we can put in circuit with a galvanometer, to give us, by combination, any number of ohms, say from 1 to 165. Such a box may be represented by Fig. 4, in which there are coils with which we can get an aggregate resistance of 165 ohms, and any number of ohms from 1 to that number. The coils, *c*, *c*, *c*, etc., are now all in, so that the total capacity of the box is represented. But if the brass plug *a* is inserted between the brass plates 5 and 10, there will be but 160 ohms in

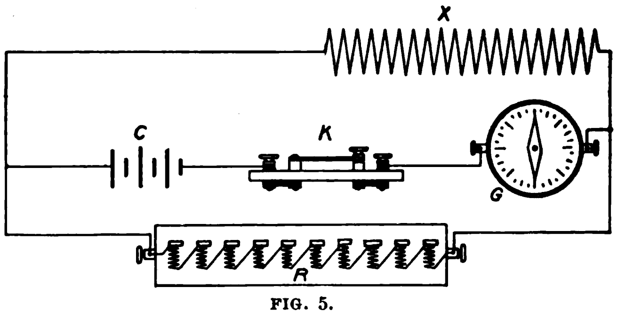

FIG. 5.

circuit, for the current will pass across the plug, without going through the 5-ohm coil. If this plug is left there and a similar plug be inserted between the 20 and 30 ohm plates the 20-ohm coil will be cut out, and we shall then be 25 ohms short of the total. If plugs are inserted between all the plates except between 1 and 2, we will have but 1 ohm in the circuit.

Now, we have all the apparatus necessary for making a comparative test of the ohmic resistance of our coil of wire.

In Fig. 5 we have a combination including a key, battery, galvanometer and coil. When we close the key the galvanometer needle will be deflected either right or left depending on the direction of the current. If the coil is of fine wire we may notice that the needle will move a certain number of degrees at first, and gradually fall back, and if we hold the key permanently closed it will finally settle at a less deflection than it first showed.

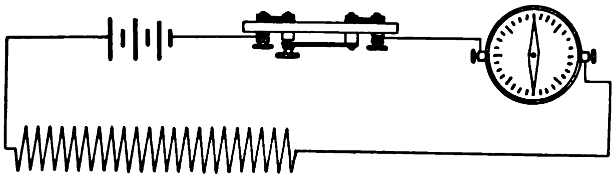
FIG. 6.

Now suppose it settled at the 15° mark. We make a memorandum of the figure, and, if we are very particular, we reverse the battery and test again. The deflection will now be in the other direction. The two readings will be nearly or quite the same. If they differ a trifle, we add the two together and divide by 2 for a mean. That is, if one measurement read 18° and the other 16°, 17° would be the mean.

Now, having arrived at this point, we take out the coil and in its place we connect the box of resistances. We close the key and insert or withdraw plugs until we get the same deflection—15°. We now have two known quantities. The galvanometer resistance and the unplugged portion of the box. The galvanometer resistance remains the same in both tests. Therefore, the portion of the box unplugged is equal to the resistance of the coil.

The disadvantage in this method of measuring is that it is necessary to have a great number of coils, which are sometimes unpleasantly large and cumbersome. The same is true of the differential system.

We have seen that the current passing around the needle in one direction deflects it to the east, and in the other to the west of the meridian. Advantage is taken of this fact in the differential form of galvanometer, Fig. 6.

The current from c, when the key K is closed divides at the galvanometer G, and amounts proportioned to the resistances of R and x pass through these back to the battery, C. Keeping the key closed, and inserting or withdrawing resistance in R until the needle of G remains at zero, we know there is exactly the same resistance in x as in R, and can read the amount in the latter.

A third method is that of the tangent galvanometer.

Ties and Poles.*

BY N. W. L. BROWN, C. E.

A thorough examination has shown conclusively that six years is the longest life we may expect of select pine.

In New Orleans excellent results have been obtained under horse car tracks with red cypress, which is reported to have been in good condition after twenty-eight years of service. Red cypress and especially black cypress are among our most durable woods, but their extreme softness and inability to properly hold spikes have been a serious hindrance to their extensive adoption for railroad ties. The extraordinary results reported in New Orleans are doubtless due to the light requirements of horse car service, and the fact that these ties were always in very damp, marshy earth, if not actually submerged in water.

A prominent timber expert of our city estimates that black cypress in our tracks ought to last about ten years' and the information before us leads us to believe that this estimate must be about correct.

We can say that the preservation of timber in quantity is confined almost exclusively to two standard, and long established processes, viz., burnettizing and creosoting. Burnettizing, or the treatment with zinc chloride, is the process (modified by patents in some cases) most extensively used in America for the preservation of railroad ties, mainly on account of its least cost, its resistance to being burnt, and on account also of its being simpler or safer than the treatments by the injections of other metallic salts.

Burnettizing is extensively used in the west, and it has given good results, especially in dry localities, but there are many conditions met with in street railway construction which are unfavorable to its success.

1st. Zinc chloride is a salt easily washed out when exposed in wet localities.

2d. Leakage currents from the rails might hasten its disappearance.

3d. It has a tendency to rust the nails and spikes.

Creosote timber is in many respects peculiarly suited for street railway ties. Creosote cannot be washed out, and being a perfect insulator, is beyond the reach of the electrolytic action of leakage currents. It might have an important bearing (especially in stringer tracks) on reducing the leakage from the rails to the water mains, etc. Its tendency is to prevent iron and steel from rusting.

For a time 6"x8"x7' were our standard dimensions for ties, but over a year ago we changed these to 5"x9"x7', and consider our present standard more satisfactory.

We have recently used three thousand sap pine ties from the Fernandina Oil and Creosote Works, and are expecting good results from them. These ties, treated with 12 lbs. of dead oil of coal tar (creosote) per cubic foot, can be delivered F. O. B. cars Atlanta, for 60 cents each. First-class pine ties now cost us 26¼ cents each, oak in quantity 30 cents each and black cypress about 40 cents each.

We know that our present scale of wages, the labor of tearing up and renewing track paved with ordinary Belgian blocks with a sand foundation and filling will cost about 36 cents per lineal foot of single track, and hence we can readily make a comparison for determining the most economical tie to use. From the information before us, we feel sure that we can safely assume twenty-four years as the life of a creosoted tie, and with this assumption we will determine the cost of keeping the different kinds of ties under sections of track for twenty-four years.

Assuming the ties to be spaced 2' 6" apart center to center. Creosoted ties will cost 24 cents per lineal feet of track, therefore 60 cents (36+24) will represent the cost of labor and ties per lineal foot in rebuilding. Principal and interest on 60 cents at 6 per cent. for 24 years, $1.46, which is the actual cost per lineal foot of keeping ties under this track for 24 years.

Cypress ties will cost 16 cents (36+16), will represent the cost of labor and ties per lineal foot in rebuilding where they are used. With a life of twelve years, which is generally assumed as the maximum in railroad practice, two renewals would be required in 24 years; therefore for the first renewal:

Principal and interest, 52 cents at 6% for 24 years.....	$1.27
and for the second renewal,	
Principal and interest, 52 cents at 6% for 12 years.....	89
Total....................................	$2.16

Oak ties will cost 12 cents per lineal foot and 48 cents (36+12) will represent the cost of labor and ties in rebuilding, where they are used. With a life of eight years three renewals would be required in 24 years; therefore for the first renewal:

Principal and interest, 48 cents, at 6% for 24 years....	$1.17
For the second rewal,	
Principal and interest, 48 cents at 6% for 16 years....	.94
For the third renewal,	
Principal and interest, 48 cents at 6% for 8 years.....	.71
Total....................................	$2.82

Pine ties will cost 10½ cents per lineal foot and 46½ cents (36+10½) will represent the cost of labor and ties in rebuilding, where these are used. With a life of six years four renewals would be required in 24 years; therefore for the first renewal:

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*Abstract of paper read at the Montreal convention of the A. S. R. A., October 15-18, 1895.

Principal and interest, 40½c, at 6% for 24 years	$0.988
For the second renewal,	
Principal and interest, 40½c, at 6% for 18 years	0.842
For the third renewal,	
Principal and interest, 40½c, at 6% for 12 years	0.696
For the fourth renewal,	
Principal and interest, 40½c, at 6% for 6 years	0.551
Total	$3.077

From these comparisons we see that with the lives assumed, cypress will cost 48 per cent more than creosoted timber. Oak will cost 92 per cent more than creosoted timber. Pine will cost 111 per cent more than creosoted timber.

We have assumed in this comparison contract prices on creosoted ties delivered here by rail from a point many hundred miles distant, and we believe that street railway companies can creosote their own timber at much less cost generally than they can expect to have it done by contract.

We feel that it would be economy for any street railway company operating extensive mileage, and affected like ourselves with short lived ties, to install a small creosoting plant on the power house premises, which are generally large, and supply this plant with steam from the main boiler plant and with power for its pumps, etc., by means of electric motors. In this way expert superintendence could be given by the chief engineer, the plant could be operated most economically, and when lying idle the interest on the cost would be about the only expense connected with it.

We estimate that a plant, consisting of a treating cylinder, 6′ in diameter and 36′ long, with a capacity of about 300 ties a day, should not cost more than $6,000 complete with necessary cars, pumps, tanks, superheating apparatus, etc., necessary for operating it. Not only would such a plant be of service for ties, but also for treating floor timbers for cars, trestle and bridge timbers perhaps, and especially for treating cross arms and—

POLES FOR LINE CONSTRUCTION.

Red cedar poles have been almost universally used in our overhead construction, although iron poles set in concrete have been used in the heart of the city, and cypress poles have been used in a few cases when we could not secure cedar promptly.

The specifications by which most of our cedar poles were purchased required 28′ in length and a minimum top diameter of 6″, but these poles proved too small and in many cases, too short, especially where guard wires are required.

These red cedar poles for this market are generally obtained in East Tennessee, although the timber exists more or less bountifully in many sections of the South. It has been used almost exclusively by the Western Union Telegraph Co. and they estimate that their poles last on an average about fifteen years. The sap generally decays in five or six years, and in many cases they find that the heart decays in twelve years, while again in many cases it will last twenty years.

Cedar poles, especially when used according to the ordinary custom, have many defects in street railway service.

1st. Their life is practically limited to the life of their sap, as when this decays the heart left is too small and weak for reliable service.

2d. Larger poles are liable to be very defective, generally being hollow at the butt, and frequently containing rotten knots.

3d. Cedar is very brittle and treacherous under tension.

4th. Large, short poles are excessively expensive, as they are equivalent on the market to long poles cut off.

We are now estimating that our cedar poles with large hearts will last twelve years. The cedar poles we have used appear to have cost us about $4.00 each, erected.

Our iron poles which have cost about $18.00 each erected, do not appear to be lasting as well as was hoped. They have too great a tendency to rust near the ground, and we doubt whether they can be safely depended upon for more than fifteen years.

We believe properly creosoted pine poles, 30 feet long 8 inches at the top ordinarily, and 10 inches to 12 inches at the top where special demands are made upon them should be equal in point to excellent service, and superior in point of long service to any poles on the market.

These poles, treated by contract to 10 lbs. of creosote per cubic foot, should not cost more than $5 each erected, and when treated in one's own plant, this price could doubtless be reduced to $3.50.

Pine in its growth is one of the most perfect and symmetrical of all timbers, besides having a tensile strength about twice as great as cedar. Creosoting is generally conceded to increase the strength, and all these properties would seem to indicate that the creosoted pine pole should be strong enough and neat enough for city work, but it is the long life that makes this pole most eminently suited for street railway work.

The Carborundum Works at Niagara Falls.

One of the more recent discoveries made through the use of the electric current is a chemical combination, atom for atom, of carbon and silicon, and called by the discoverer, Mr. E. G. Acheson, carborundum. It is in a crystaline form, and one of the best abrasives known. The limited output of the works at Monongahela, Pa., was sufficient to supply only the dental, jewelry and a few like trades. When the new works are fairly going, and the price has been reduced, it will be used in all kinds of establishments where emory and similar abrasives are now used.

The company some time since contracted with the Niagara Falls Power Co. for 10,000 horse-power, to be delivered as required. The old plant being operated by steam power, the product was correspondingly expensive. The present works at Niagara Falls are using 1,000 horse-power, but the works when at their full capacity will take 3,000 or 4,000 horse-power. The works will be gradually extended.

The stock building, in which the crude material is received, has a railroad track running into it from the Niagara Falls Junction R. R. Cars loaded with coke, salt, sawdust or sand are run into the building and emptied into their respective bins. This building is equipped with grinding and mixing machinery, by which these ingredients are prepared for the furnaces, with as little expenditure of labor as possible. When prepared the mixture is conveyed to the furnaces in the adjoining building.

The furnaces are crude looking affairs, laid up with brick without mortar in the form of an oblong box, fifteen feet long and seven broad. At the center of each end is a large bronze plate, to which the large electric cables are connected. From the inner surface of these plates project sixty carbon rods about two feet long, passing through the wall and projecting into the interior. About ten tons of the mixture of sand, coke, sawdust and salt are placed in a furnace at a charge. In the center of this mass is placed a cylinder of crushed coke, forming an electrical connection between the carbon terminals at the ends. This core is about nine feet long.

When the furnace is ready an electric current of one thousand horse-power is turned on and kept on for twenty-four hours. The furnace in an hour or two shows signs of the intense heat within. The gases escaping through the crevices of the brick walls burn with a slight flame. In about twelve hours the bricks have become red hot and the entire furnace glows with the intense heat. When the attendant observes indications that the current has been on long enough, the cables are disconnected from this furnace and connected to the bronze plates of the next.

When cold the furnace is opened and to the core are attached the carborundum crystals, spreading out in all directions. Around the mass of crystals is a cemented mass in the form of a shell. The crystals from the furnace are passed through iron rolls, by which process they are crushed apart and separated. After being washed with acid and water and dried they are ready for shipment.

J. W. Mackay, jr., son of John W. Mackay, of the Commercial Cable Co., was almost instantly killed the first of the month by being thrown from his horse.

The Design and Construction of a Motor Starting Box.

BY E. D.

In the design of any piece of apparatus the mechanical features should receive careful attention. It matters not for what purpose the apparatus is designed this point should not be overlooked. American designers probably give more attention to the proportions of their machines than those of any other nation. Use just enough material for the requisite strength with a good factor of safety; a little added perhaps here or there to give the outlines a neat and trim appearance; the whole placed together compactly so as to occupy as little space as possible and to reduce the size and weight of the supporting frame. The looks of any piece of machinery has great weight with any purchaser, whether he be an expert or totally unacquainted with the technical features of the mechanism. We will leave these general features, however, and consider the main points of a starting rheostat for a motor of five horse-power capacity, built for 230 volt circuits.

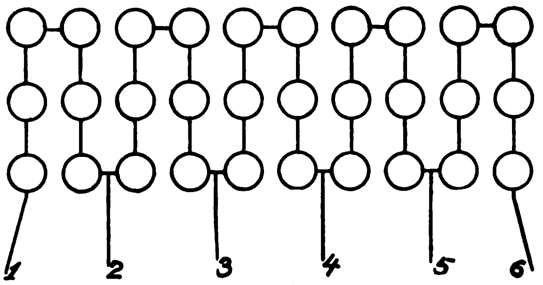


FIG. 1.

For the coils galvanized iron wire will be used of a size to carry the full amount of current without excessive heating. What this size is must be first determined and depends upon the amount of current to be carried. Since the motor should have an efficiency of at least 80 per cent, the amount of current per horse-power at 230 volts would be approximately four amperes or 20 for the five horse-power motor for a full load. The first rush of current at starting would be a like amount. Since according to Ohm's law the resistance equals electromotive force divided by the current, the resistance of the conductor would be 230 divided by 20 equals 11.5 ohms. The resistance of the armature from brush to brush would be about one ohm, so we may decrease the conductor that amount.

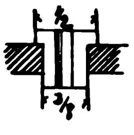


FIG. 2.

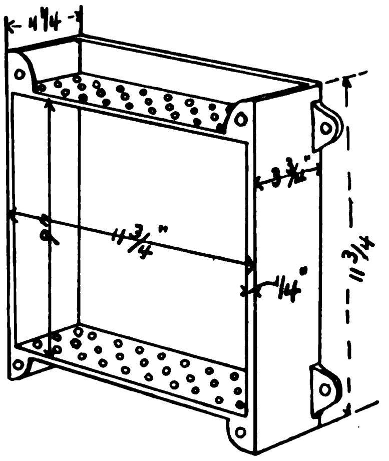


FIG 3.

The wire is to carry this amount of current only for a very short period, perhaps a fourth of a minute, so the wire will have a much smaller rated capacity. From a table of capacities and resistances of iron wire it is found that a wire .063 of an inch in diameter will carry five amperes without heating and by experience it has been found to carry for a few seconds four times as much. This is the size of wire to be used in this starting box.

As it will require a considerable amount of this wire it must be put in such shape as to use as little space as possible. It is commonly wound in coils and these coils arranged in a frame in a compact manner. By winding it tightly on a half-inch mandrel the wire is soon made into coils. The wire will have a spring to it and when removed from the mandrel the coil will have a mean diameter of five-eighths of an inch. The length of one turn would be a little less than two inches, more exactly, 1.964. When the coils are placed in their supporting frame it is necessary that they be placed under slight tension to prevent the convolutions touching and should be supported at short intervals. When so arranged there will be about 130 convolutions per foot. If coils are long there will be less as the tension will be greater.

In each foot there will be 21¼ feet of wire (1.964x130 = 255.32 = 21.27 feet). The resistance of this wire as shown in the table is .0233 ohms per foot which is .4962 ohms per foot of coil. To give a resistance of 10.5 ohms will require 10.5 divided by .5 ohm or 21 feet of coil. For several reasons it is preferable to use short coils and to have them placed in a vertical position, so in this rheostat 30 short coils will be used 8.4 inches in length. Fig. 1 shows a good arrangement of coils, the connecting wires and leads to the terminal points, which number six in accordance with rules laid down in a previous article.

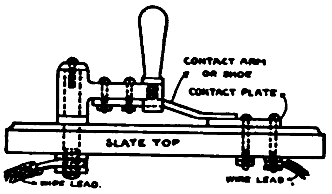


FIG. 4.

For insulating these wires from the iron frame porcelain insulators will be used, as shown in Fig. 2. These will be so spaced as to place the coils one and one-sixteenth inches apart. The space required for the coils within the frame would be the sum of three diameters of coil plus the space between coils and coils and frame, or three and three-quarters inches. In length, found in the same manner, 11¼ inches. The frame may be cast iron, one-fourth or three-sixteenths of an inch in diameter, the ends cast solid and holes drilled to take the bushings. The front corners of the frame are filled and raised sufficiently to allow the fastening of the slate front with room for the wires leading to the contact plates. At the sides on the back are lugs with holes to allow for bolts or screws to fasten the starting box to wall or post.

The ends of the box may be covered with sheet iron screwed to the corners. The slate face should be about three-quarters of an inch thick and should project at least one-forth inch beyond sides of frame. Thus it will measure 12¼ by 12⅜. It will have six plates on its face corresponding to the six terminal wires shown in Fig. 1, and one plate for the "off" position, making seven in all. Fig. 4 illustrates the connections to the central post of lever and the contact plate. The slate face also contains three terminal posts which is customary on boxes for shunt wound motors. One of these posts is marked L and is to be connected to one side of the line. It is also connected under the slate to one of the others that is marked F, meaning that it is to be connected to one side of the field and is also connected to the lever arm or contact shoe. The third post marked A, is connected to the wire marked 6, Fig. 1, and should be connected to one armature terminal as shown in sketch Fig. 10.

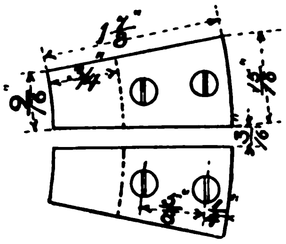


FIG. 5.

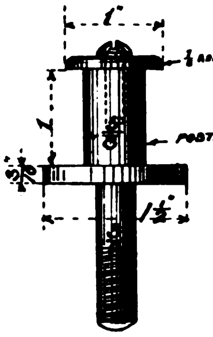


FIG. 6.

The contact plates are one-eighth inch sheet brass, cut as shown in Fig. 5, with a radius of 3¾ inches to the inside circle and fastened as shown in Fig. 4. Three-quarters of an inch surface should be allowed for the contact of lever arm. The central post of contact arm should be made as shown in Fig. 6. The three terminal posts can be made as shown Figs. 8 and 9. The contact is good and there is no liability of the wires working loose when once fastened. They are also easily constructed and easily fastened to the face of starting box.

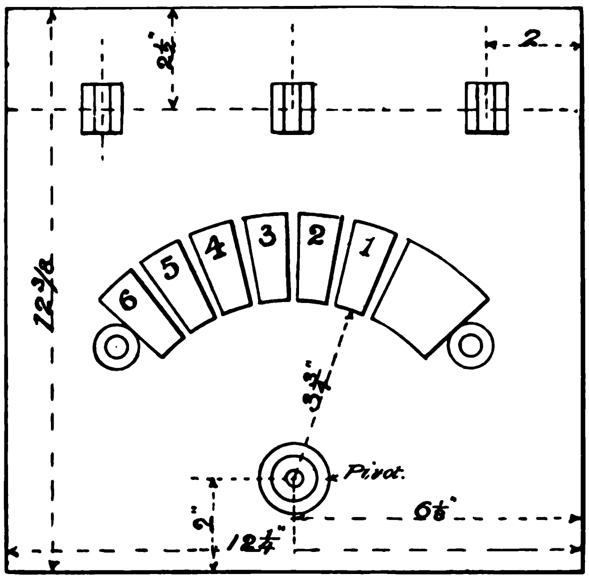


FIG. 7.

The general arrangement of the slate face is illustrated in Fig. 7. At each end of the row of contact plates is placed a stop to prevent the arm moving farther than is necessary. The " dead point " may consist of two plates as shown separated from the next by at least a quarter of an inch. The starting box now stands complete and if the work has been executed in a thorough manner, it is a merchantable article and capable of occupying a position at the side of any of those now on the market. By following the same method starting boxes may be constructed for motors of any size. The computations for sizes would be made in the same manner. The arrangement should be such as will give the most compact form consistent with good construction.

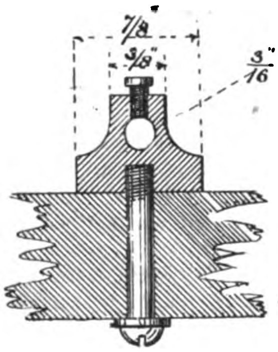


FIG. 8.

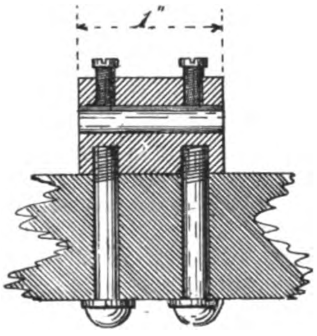


FIG. 9.

A Disastrous Fly Wheel Explosion.

A disastrous fly wheel accident occurred the first of last month at the power house of the Hudson Electric Light Co. at Hoboken, N. J. The large fly wheel, twenty feet in diameter, and weighing about 50,000 pounds, went to pieces, killing the engineer and doing a considerable damage to the building and equipment. The engine was a vertical compound Corliss engine with the drive wheel mounted upon the center of the crank shaft between the two cylinders. Above this wheel was a walk by which the cylinders and valve mechanism was reached. The engineer stood upon this walk at the time of the accident and his mangled body was found hanging from one of the roof trusses.

The engine was rated at 500 horse-power and ran at 125 revolutions per minute. The engine was located at the west end of the long engine room. These engines are belted to line shafts in the lower story under the dynamo room. The engine room is between the boiler room, which is on the north, and the dynamo room at the south, separated by brick walls. The wheel went to pieces all at once and destroyed nearly everything in the vertical plane. One piece weighing about a ton and a half went through the wall of the boiler house, up through the roof and about 750 feet north. Another piece took the opposite direction and passed through the wall of the dynamo room, through the roof and plowed up the pavement in a street beyond. The smaller fragments did general damage to steam pipes, pulleys, shafting and the equipment. The noise of the explosion and escaping steam awakened the residents for a considerable distance, the time being about 3:30 A. M.

Although there were seven or eight persons in the building at the time the only one who knew the circumstances of the accident was killed. It was reported that a short time previous to the accident a couple of fuses were blown and that during their replacement the engineer slowed the engine down by holding up the governor. When the engine again came up to normal speed the fuses were blown again and it is thought that the engineer got " rattled" and held the governor down instead of up. The wheel appeared in good condition and there seemed to be no fault in design nor flaw in construction. The rim was in eight sections, about two and a half inches in diameter with a rib at each edge and another in the center. The sections were united by strong wings, securely bolted.

The wreck of engine and everything in its path was most complete and both the lighting systems and electric railway were crippled. Carl Anderson, the engineer who was killed, had been with the company about two years and was considered a careful man.

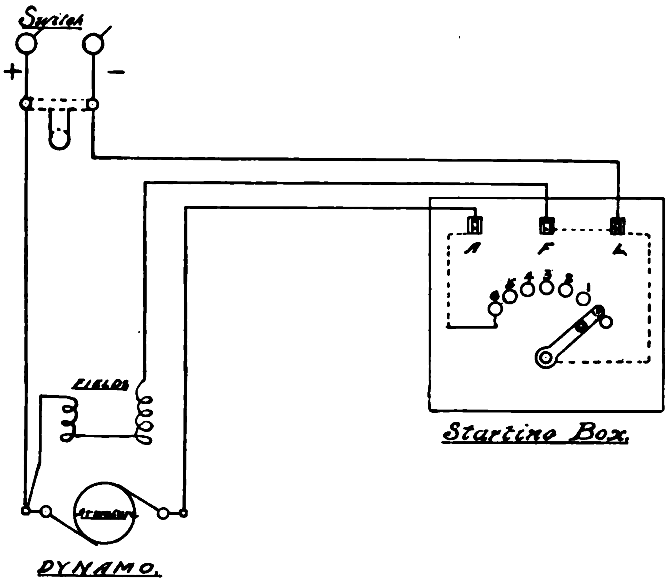


FIG. 10.

The Boston Electric Subway.

Work has been commenced on the new Boston subway. The trains that will run through it will be operated by electricity, and there will be no smoke. With electricity for power, light and heat, the inconveniences and objections of the tunnel are done away with. A special plant will be erected for furnishing lights for the entire tunnel. The work is being done under the direction of the Boston Transit Commission. The expense is to be borne by the sale of bonds, the interest on which, it is expected, will be met by the rentals from companies using it.

The commission has the power to remove all street car tracks on streets above the tunnel, if necessary, to compel the companies to use the tunnel. The commission will repave the streets, move water, gas pipes or sewers; in fact, have full charge of the work, both during construction and after completion. The subway lies as near the surface of the ground as possible. It is constructed in such a manner as to stand by its own strength, so that excavations near it will not affect it. The top is steel beams supporting brick arches; for the bottom, similar construction, with arches inverted, and for the sides masonry.

LESSONS IN PRACTICAL ELECTRICITY

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

The Primary Battery.

BY D. D.

While static electricity has been known for centuries, it is but a little more than one hundred years since galvanic electricity was discovered. Galvani had but a faint idea of his discovery, and his theories regarding it were in many respects defective. Volta, who later repeated the experiments, corrected some of the theories and added many discoveries of his own to those of Galvani. The electricity of the primary battery is now as commonly spoken of as voltaic electricity from the noted discoverer. The discovery of induced electricity, as produced in conductors, passed through magnetic fields, was made at a still more recent date, and the identity of electricity produced in the two different ways established.

The electricity is produced in the primary battery by chemical decomposition; that is, by the breaking up of certain chemical compositions and the formation of other combinations of the elements composing the first combinations. If in a glass or earthenware jar partly filled with sulphuric acid and water (nine parts of water to one part acid) a plate of zinc and a plate of copper be placed, we shall have one of the simplest forms of the primary electric battery. When the metal plates are so placed, bubbles may be observed to collect on the plate of zinc; but if the wires attached to the plates are connected, as shown in Fig. 2, the bubbles will be observed to rise from the copper plate, and a current of electricity will pass over the wire. The simple fact that the wires are connected has made a great change in our battery. If the wires are separated, chemical action ceases, and also the electric current.

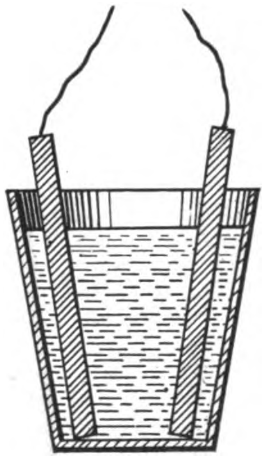


FIG. 1.

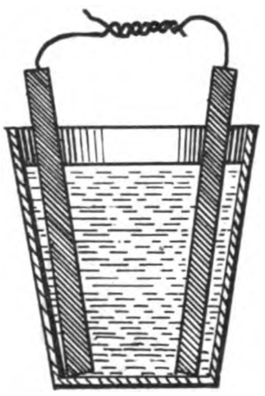


FIG. 2.

Before the wires were connected the jar contained sulphuric acid (molecules of which are composed of two atoms of hydrogen, one atom sulphur, and four atoms of oxygen) and water, with the plates of zinc and copper. After the battery has been in operation for a time, it will be found that the molecules of acid have been throwing away the atoms of hydrogen and taking up the atoms of zinc, forming zinc sulphate. The bubbles rising from the copper plate will be found to be the hydrogen released from the acid. This process would continue until either the acid or the zinc was used up. It is from this or similar chemical changes that electricity is produced in the primary batteries. A certain amount of acid and zinc in this kind of cell must be changed to zinc sulphate and hydrogen to produce a definite amount of electricity. If the battery is to continue producing electricity, it must be supplied with material with which to work. Several theories have been put forth to account for the production of electricity from chemical decomposition, but none of them is entirely satisfactory. In the above battery it will be observed that the copper plate is not affected by the acid, and serves only to conduct the electricity from the fluid.

It is frequently asked by persons unacquainted with the manner in which electricity is produced in the electric battery why this is not the better way of producing electricity for lighting purposes. They do not understand how large a battery would be necessary to give the requisite amount of current, nor the cost of the material used in the battery. The metals used in the battery must be of such kinds as are acted upon unequally by the acid. Platinum would answer as well as copper, as it is not affected by the acid. Platinum is, however, too expensive for ordinary service. Carbon has been found to answer as well for a conducting plate, and is therefore extensively used in several forms of primary batteries.

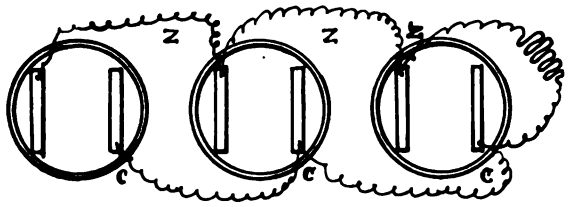


FIG. 3.

If the plates in the cell are small, the amount of current produced will be correspondingly small. The electromotive force will be the same, no matter what size the plates may be. It was found that if the copper plates of two similar cells were connected, the zinc plates connected, and the wire from the zinc joined to the wire of the copper, the quantity of electricity would be doubled. If three cells were so connected, the result would be three times the quantity. Cells so connected are called a battery of quantity. If the zinc of one be connected to the copper of the next, and the zinc of the second be connected to the copper of the third, the quantity of electricity passing over the wire connecting the zinc of the third to the copper of the first will be no more than that given by a single cell. The electromotive force will be approximately three times as great. A battery so connected is called a battery of intensity.

From this simple form of battery and the laws discovered in connection therewith other improved styles of batteries have been designed which have a greater capacity, intensity and durability. Many of the great discoveries in chemistry and electricity were made by the use of the primary battery, which was brought to great perfection before the dynamo electric machine was invented. Their use, however, although it has increased to an enormous extent, has been curtailed by the more general use of the electric generator and improvements in devices for reducing the pressure to any desired amount. The telegraph, formerly entirely dependent upon primary batteries for its current, is now using the current from dynamos in the larger stations. This innovation was made on the score of cheapness and reliability.

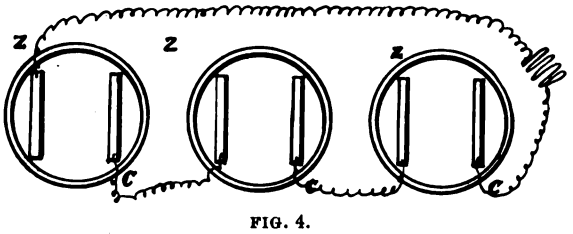


FIG. 4.

Eugene Langen.

Eugene Langen, one of the directors of the Otto Gas Engine Works, died on Oct. 2 at his country seat, Elsdorf, near Cologne. He was also interested in the manufacture of gas engines in Germany. He was possessed of a large fortune.

The Arc Lamp.

In the accompanying cut, Fig. 1, is shown the simplest form of the arc lamp. Such lamps are sometimes found in work rooms where the light is used for photographic printing or similar purposes. It requires constant attention and therefore can be used only where attendants are at hand to adjust the carbons. It is only a makeshift but when properly cared for answers every purpose. The upper carbon and holder is supported by a weight, W, attached to the opposite end of the string passing over the small pulley. The pulley does not turn easily so that as the carbon becomes lighter by being consumed the weight does not move the carbon. When the distance between carbon points exceeds that required for a good light the upper carbon must be lowered by pulling down on the cord and raising the weight. Frequent attention is thus necessary which is hardly in accord with prevailing ideas in this age of automatic machinery.

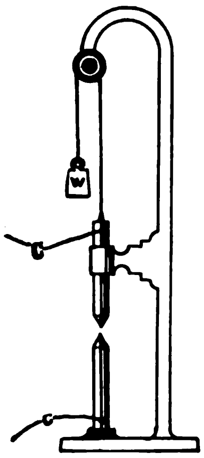


FIG. 1.

To make such a lamp self-operating means must be employed for separating the carbon points and keeping them the proper distance apart. To invent such a mechanism was the task Mr. Chas. F. Brush set about and accomplished so perfectly that but few fundamental changes have been necessary in the lamps which were used on those first arc lighting systems that made his name famous.

Some years previously Paul Jablochkoff, a Russian inventor, placed on the streets of Paris arc lamps in which the carbons were placed side by side in a vertical position. They were separated by an insulating material that melted as the carbons burned down. The arc was first established by a fuse made of carbon and some adhesive material but should the lamps go out from any cause another fuse must be inserted before the arc would be established. An alternating current was used so that the two carbons would be consumed with equal speed. The life of the carbons was short. The lamp, or candle as it was called, attracted great attention but these defects and the invention of the present type of arc lamp prevented its further use.

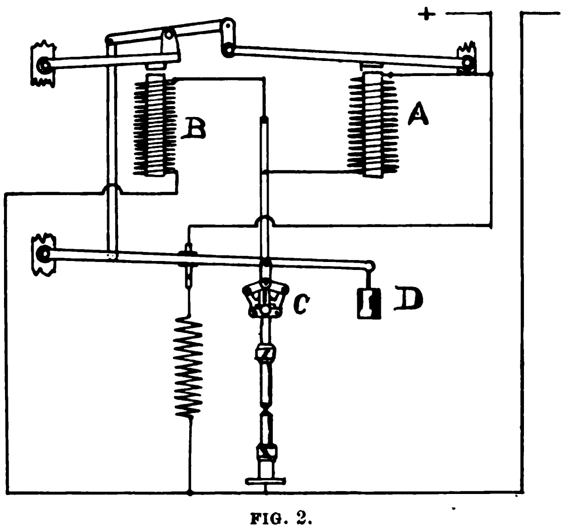


FIG. 2.

In designing the mechanism for the regulation of the arc it was reasoned that as the carbon tips approached each other the resistance decreased and as they burn away and the distance between carbon points increases, the resistance increases. To make the variation in the resistance of the main circuit effect the regulation of the arc was the problem at hand. Shunt wires wound in bobbins and producing motion in the carbon rod through the magnetic effects transmitted either direct or through levers are usually employed. Motion is directly applied to the carbon rod by two general methods, the clutch and the gear. The operation is best explained by a description of lamp mechanisms now in use in the lamps of the older manufacturing companies.

The accompanying diagram illustrates the regulating mechanism of the Western arc lamp. The course of the current in passing through the lamp is easily followed by the lines. This lamp belongs to the clutch type. The carbon rod is raised by means of the clutch, C. In the main circuit is placed a coil, A, with a soft iron core. In the shunt circuit is placed another coil with iron core B. The current having been turned on the magnet, A, will draw down the lever above it which will act through the second lever and raise the lower lever to which the clutch is attached. When the arc has been drawn and the resistance of the main circuit has been increased to that of the shunt, the magnet, B, in the shunt circuit will commence to act against it. When the resistance of the main circuit exceeds that of the shunt the lower lever will be forced down releasing the carbon rod, which will slip past the clutch until raised by the magnet, A, the strength of which has been increased by the normal flow of current. The power of these two magnets will tend toward a balance which will be broken by the burning away of the carbons. As this occurs they will adjust the carbons and seek to maintain them the distance apart for which the lamp is adjusted.

Any vibration of the rod is checked by the dash pot, D. The clutch grasps both sides of the carbon rod; this means of raising the carbon rod is advocated by some as the surer method. The mechanism of other lamps will be taken up subsequently.

The Motocycle Contest.

A contest of motocycles has been arranged by the Chicago Times-Herald to take place on Thanksgiving day. Prizes are offered the participants amounting to over five thousand dollars. The race is to be conducted in a manner similar to that followed in contests in Europe, except that the distance is much shorter than the recent contest in France. The course as laid out begins at Jackson Park, and by a specified route over a distance of about one hundred miles, ending in Lincoln Park.

The majority of the motocycles entered are operated by gas or oil motors, and a few by electric motors fed by storage batteries. Messrs. Morris & Salom have entered two motocycles which they call "electrobats." They are of two sizes, the larger seating four and the smaller two persons. The larger has much the appearance of an ordinary carriage, as the machinery is entirely enclosed. Two motors are attached to the front wheels. The steering is effected in about the same manner as the carriage exhibited by the American Storage Battery Co. at the World's Fair. The steering wheel and controller are placed in front in reach of persons occupying the front seat. The wheels have pneumatic tires and ball bearings.

The battery is placed in the body of the carriage, and consists of four sets of 12 cells, which have a capacity of 50 ampere hours. On good roads it is claimed that the carriage can make twenty to twenty-five miles an hour. The smaller "electrobat" is built on the principle of the bicycle, with tubular steel frames, steel spoke wheels, pneumatic tires, ball bearings, but is geared and steared in the same manner as the larger vehicle. It weighs, complete, with battery, under 1,200 pounds, while the larger weighs nearly 400 pounds more. Other electrically propelled vehicles have been entered, one by Mr. B. J. Arnold, of the Pumpelly-Sorley Storage Battery Co.

The conditions of the Paris-Bordeaux motocycle contest did not permit the entrance of electric vehicles, since a carriage could not carry sufficient storage battery capacity for the long course over which the contest is made. This race will start at 8 o'clock in the morning, and it is expected that Lincoln Park will be reached before sunset. The trip must be made within thirteen hours or the contestant will be disqualified.

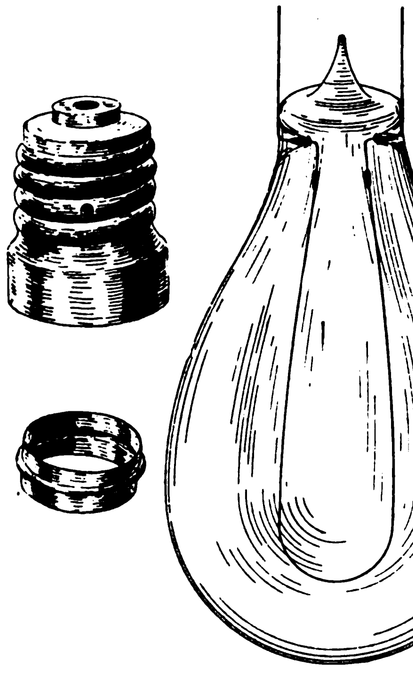
"I am well satisfied with your paper." T. F. Grover, Supt., Milwaukee & Wauwatosa Elec. Co.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion.]

The A-B Incandescent Lamp.

Incandescent lamps have assumed approximately the same form in the hands of the different makers and nearly the same processes have been followed. In the new lamp placed but recently on the market by the Adams-Bagnall Electric Co., of Cleveland, Ohio, several marked changes are noticeable. The end of the bulb through which the light eminates is perfectly rounded and the glass is of uniform thickness and transparency. That pointed mass of glass in the ordinary lamp that shuts off the light and makes such a dent in your head when brought unexpectedly in contact with it, is not found in these lamps.


THE A-B INCANDESCENT LAMP.

The bulb is sealed at the base end, which seems to be the proper place. By pressing in the side of the bulb at the lower or small end of the neck a mount is constructed for the filament. The platinum wires are passed through the glass at diametrically opposite points. No bridge or mount of any kind connects the wires and no short circuit can occur at that point. The usual cumbersome glass mount is dispensed with and the neck is left free for tubulating for the exhaustion of the air and the sealing off.

In the manufacture of the filament an improved form of the cellulose process is employed, which gives great toughness to the filament and additional life to the lamp. The small brass ferule shown in the accompanying cuts is placed upon all bulbs as soon as completed. This allows time for the hardening of the setting. The bases of whatever style desired are then placed on the bulb. The bases are fastened by mechanical means and can be fastened in very short time. It is a simple and secure arrangement and guards against defects appearing in this part of the lamp.

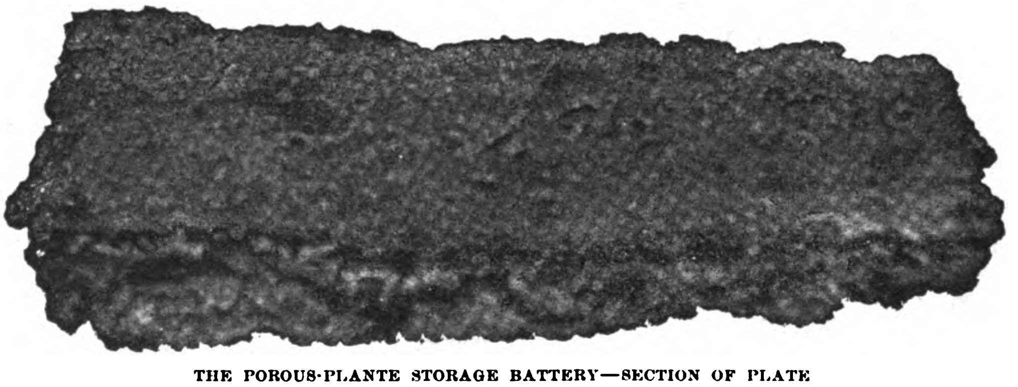
The Porous-Plante Storage Battery.

The Planté cell originally consisted of a great many very thin strips or ribbons, which with the cost of properly connecting and the long time required to form, limited its adoption to any great extent, until a few years ago, when the powerful currents now used in forming, and improved processes for treating the lead, have made it possible to form the plates in a few weeks instead of months. As it requires a great many strips to make a cell of ordinary capacity, and lead costs more per pound the thinner it is rolled out, the cost, before forming, of a cell of this kind, is such as to limit its commercial use.

Various means have been devised to produce the necessary surface and at the same time reduce the cost of manufacture. Among others might be mentioned that of compressing small particles of lead into a plate by means of hydraulic pressure, and also that of making a lead felt of fine strings of lead. Plates made by those methods have the disadvantage of being very fragile, especially that in which the particles are pressed into a mass, it being possible to pull it in pieces by hand. The resistance is naturally high owing to there being no continuity in the metal, a film of oxide surrounding each lead particle or string.

What is called the "Porous-Planté" battery is entirely free from the faults above enumerated. The plates are not made porous through pressing a number of particles together, but each consists of one continuous mass of lead with a sponge-like formation which gives a very large surface whether the plate be thick or thin. The active material that is formed from the lead by electrolytic action is held securely in the innumerable irregularly shaped cells and corrugations throughout the body of the plate. As the process of making the Porous-Planté plate is very interesting and many inquiries have been as to whether this is a secret process, it is well to state that there is no secret whatever, the battery being thoroughly covered by patents.

The method will be briefly described here: To begin with, it is well to state that pumice stone is used in a granulated state and is mixed with lead when the same is in a pasty condition, which it is brought to by heat, and kept in that condition, by proper heat regulators, until the mass is well kneaded, when it is pressed into a form or mold of the required shape, and left for a minute to cool. In the act of mixing, the heat expands the air in the pores of the pumice stone, which expansion causes the multitude of cells to form throughout the lead. An examination of a section of a plate with a microscope will show that for every particle of pumice stone seen, there are hundreds of thousands of minute cells formed by the tendency of the heated air to force its way out. The porosity of these plates is such that a plate 9x7x½ inches, will absorb 5½ ounces of water.


THE POROUS-PLANTE STORAGE BATTERY—SECTION OF PLATE

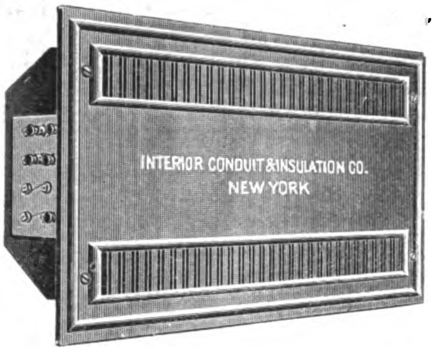
The particles of pumicestone can be eaten out of the lead by a simple process, if desired, but as there is only 10 per cent of solid matter in it, and being electrically inert, it makes no difference whether it is left in or is taken out. It is obvious that the method allows of great variations in the porosity, and therefore in the weight of the plates, but it is found that 5 per cent in bulk, of pumice stone is a fair average amount to use.

A cross-section of a plate is shown here in the accompanying cut. It has been mentioned that plates of this kind can be made either thick or thin, and have an equal amount of porosity. While the porosity is the same, it has been found advisable, after a long series of comparative tests, to discard very thick plates for those $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in thickness. Plates one inch thick, although of the same porosity as the thinner ones, take longer to form, and also have a much lower rate of charge and discharge per pound of lead.

The "Standard Storage Battery Co." owns the United States patents for this invention—with temporary offices at No. 50 Exchange Place, New York, and has adopted the name of "Porous-Planté" as a designation for these plates and batteries, as particularly a happy one, inasmuch as it thoroughly describes them.

I. C. & I. Co. Car Heater.

The accompanying cut illustrates the electric car heater built by the Interior Conduit & Insulation Co. of New York for electric railways. In the design of this heater it has been the aim to produce a heater that will be economical in operation. It is not sufficient that it produce the requisite amount of effective heat but it must produce it in an efficient manner. In the design of the heater first consideration has been given to securing a free circulation of the air to be heated and causing that air to completely traverse all the heating surface employed. There is no dormant heat; what is created is put in circulation through the constant circulation of air.



I. C. & I. CO. CAR HEATER.

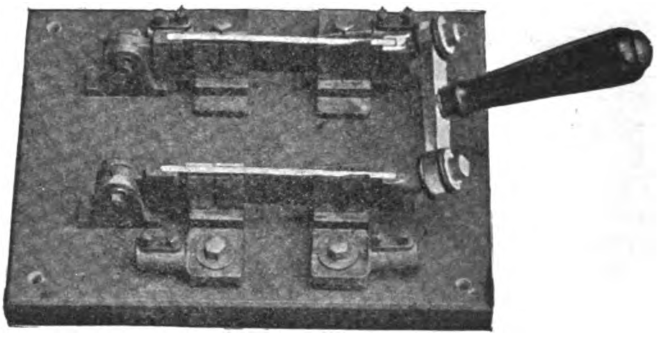
There is always a certain amount of loss attending the conversion of energy from one form to another. The efficient machine is the one that makes this loss as little as possible. By the form in which this heater is constructed the cold air is drawn from the car, passed through the heated coils and out into the car. The heat is constantly taken from the coils and a steady and continuous stream of warm air flows into the car. The air does not pass by but through the coils and as fast as the heat is generated it is carried where it is wanted. The results obtained from these heaters are said to be economical, a large saving in consumption of power being made.

The regular standard sizes give four heaters in series for an ordinary car and six in series for long cars, each series taking four amperes at 500 volts. The heaters are well constructed, neat in appearance and easily installed. They take up no valuable room and do not have to be taken out during summer season. These heaters are also suitable for offices or rooms of any sort either in buildings or staterooms on steamships.

An Improved Line of Switches.

Even in the simpler and older electrical appliances improvements are constantly being made. Switches, which are made in great variety to fill the numerous demands of every electrical installation, have been reduced to great simplicity. Yet improvements are constantly being made as is evident from the lines of switches manufactured by J. Grant High & Co., of Philadelphia and handled in the west by the Metropolitan Electric Co. Chicago the general western agents, for which the manufacturing facilities have been recently doubled.

In the accompanying cut is shown one of the smaller sizes of the double pole knife switch. The contact clips are securely bolted to the base and accurately placed. The blades fit closely and perfect contact is secured. It the larger sizes, this type of switch being made up to 10,000 amperes capacity, the blades are divided so as to give a larger contact surface and a large carrying capacity. The metal used in the manufacture is carefully selected and must reach a high grade on being tested before being used.

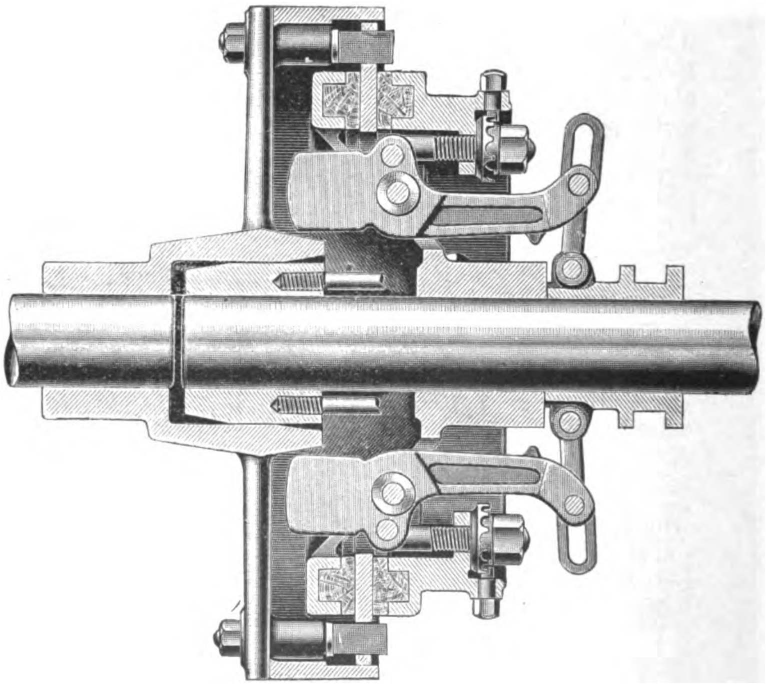


AN IMPROVED LINE OF SWITCHES.

The line of switches manufactured include almost every size and kind required in electrical installations. They are made in standard sizes and a large stock is carried so that customers may be served promptly.

A New Cut-Off Coupling.

The E. W. Bliss Company, of Brooklyn, N. Y., manufacturers of the Waldron flexible friction clutch pulleys, have adapted the principles of that clutch to a cut-off coupling, which would seem to be worthy of special notice. The clutch parts are the same as in the flexible friction clutch pulleys made by this company, and the coupling therefore possesses the same merits of flexibility, simplicity and compactness as the clutch pulleys. A special feature is the centering device, which will be understood by the accompanying sectional view.



A NEW CUT-OFF COUPLING.

Ordinary line shafting, especially when of small diameter, is liable to run slightly out of alignment. In consequence of this, if two shafts are coupled by a cut-off coupling, when the coupling is thrown out of operation and one shaft allowed to revolve while the other remains at rest, the revolving shaft may not turn perfectly true with the other. If there is no bearing provided to prevent this and hold the two shafts in line when coupled and revolving together, the shaft as a whole will have an eccentric motion, bringing injurious strains on the larger bearings and beltings. On the other hand, where such a bearing is provided, when the shafts are uncoupled, the bearing is rapidly worn away on account of the eccentric motion of the revolving shaft. To provide against these contingencies, this coupling is made with the centering device shown. When thrown out, the cone is withdrawn from the recess in the opposite member, allowing each shaft to take its natural position and revolve freely without any wearing surfaces. When the shifter is moved to throw the clutch into operation, before the friction rings grip the flexible plate, the cone brings the two shafts in alignment and insures the clutch and shafts revoloing properly together.

The Graphite Rheostat.

A novel form of rheostat called the "Graphite" has recently been placed on the market by the Graphite Rheostat Company, Chicago. The accompanying cuts illustrate both the details of construction and its appearance when finished. Although the general form of its case is similar to that of the ordinary wire rheostat its construction bears no resemblance. The sliding arm and row of contacts are wanting in this rheostat although the hand wheel on the face is turned in the same manner.

Fig. 1 illustrates the construction. Through the sides of the frame pass the rods C, D, and upon these rods are mounted the small slate slabs R, S and T. Between the plates R and S are iron cylinders as shown, the whole being firmly held together by the shorter rods at the sides. These iron cylinders are filled with a specially prepared graphite as shown in cross section at Z. From the slate plate T project the rods a a a a, which enter the cylinders. A rack B moved by the pinion A carries the cylinders over these rods. At the base of each cylinder is a brass button on the end of bolt X. When the cylinders are carried up so that the rod touches the brass button the entire resistance is cut out and there is a clear path for the current established. As the cylinders reach that point the switch in the corner is tripped and the rheostat is cut out of circuit.

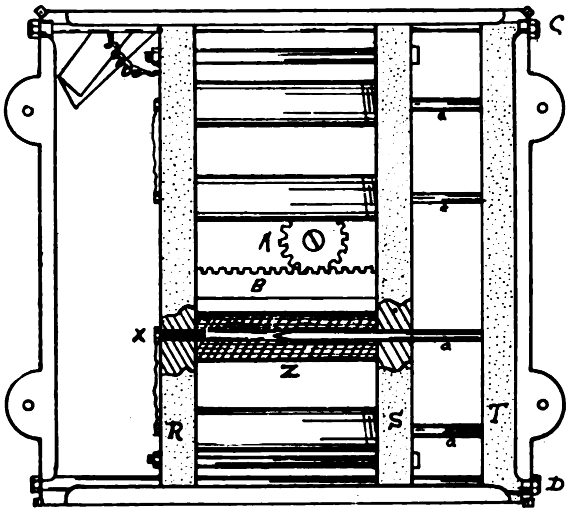
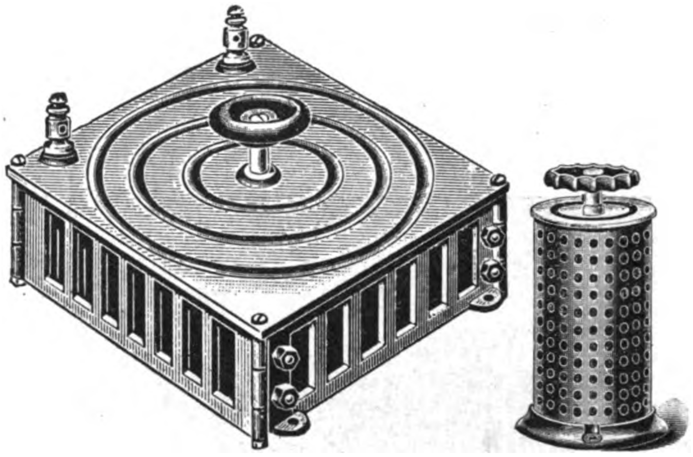


FIG. 1.—THE GRAPHITE RHEOSTAT.

Suppose it is desired to place a resistance in the circuit. By turning the hand wheel the rods leave the brass buttons at the base and at the same instance the switch is opened, throwing the rheostat in circuit; the current will then pass in series through the small sections of graphite in the cylinders. By turning the wheel farther, drawing out the rods, these sections are increased in length and the resistance in circuit increased in a proportionate amount. It will be seen from this that the amount of resistance is capable of an infinite number of variations. The number of contacts on the largest rheostat is small in comparison. This advantage will be found of value in the accurate regulation of generators, in dimmers, etc.

The material used in this rheostat is not affected by heat or cold, so that there is no danger of a burn out. There being no sliding arm and contacts to wear out makes it a durable piece of apparatus. The case is of iron and of a form that gives good ventilation. The method of construction permits the making of rheostats of any resistance an easy matter. Resistance cylinders of a fixed resistance can be supplied.

This form of rheostat can be used with electro-medical apparatus and for similar purposes, in the charging of storage batteries where current of an exact amount and voltage is desired, as a motor starting box or a rheostat for the regulation of dynamos. Its construction, as will be noted, is exceedingly simple. There are no soldered connections. No wires to become brittle and break. No contacts to accumulate dirt. In Fig. 3 is shown a resistance cylinder of a different form, in which the same method of construction is employed. The case and hand wheel are nickel plated.



FIGS. 2 AND 3.—THE GRAPHITE RHEOSTAT.

Prizes for Conductors and Motormen.

On the Brooklyn Heights railroad a new order has recently gone into effect, whereby all conductors and motormen in good standing and having no accidents shall receive a pro rata share in a fund of $10,000 set aside by the company for that purpose. The order issued by C. L. Rossiter, president, reads as follows:

"In connection with the new order of this date requiring all conductors and motormen to wear full uniform, the board of directors of this company has authorized the setting aside of $10,000 to be divided among conductors and motormen as follows:

"All conductors and motormen in the employ of the company on this date and who, between now and May 1, 1896, shall have had no accident causing either injury or damage to other persons or property or to the property of the company, and who have not been suspended for violation of the company's rules, will receive on that date a pro rata share of the above sum.

"The management deserves to impress upon the employes that the success and prosperity of the company depend upon safe, regular and quick service, together with courteous treatment of the public by its employes, and the payment of this amount is authorized in the hopes of securing more efficient and conscientious service on the part of both conductors and motormen, and thus improving the service on the company's lines."

It is reported that the Electric Storage Battery Co. is making arrangements for the erection of a manufacturing plant at Niagara Falls where it will have the advantage of the cheap power. The company has recently purchased the business and patents of the Pumpelly-Sorley Storage Battery Co. which has conducted the manufacture of storage batteries at Chicago for a number of years. The batteries were manufactured under the patents of Messrs. Pompelly and Sorley. The batteries were largely used in telephone, phonograph, and lighting service.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. *Copyrighted 1895.* ELECTRICAL INDUSTRIES PUB. CO. Commenced in Vol. VI, No. 2.]

122. *Is there a magnetic field about a current ?*

Yes. This can be seen by sending a current of ten amperes or more through a wire and dipping the wire into iron filings or sprinkling iron filings upon it. The iron particles will stick to the wire only when current is passing. A needle will also be deflected if brought near a wire—in fact, this principle is used in many instruments for measuring current.

The field about the wire may be studied by means of iron filings, as suggested above. Pass a wire verticall throughy a horizontal piece of cardboard upon which some iron filings have been sprinkled. Send ten or twenty amperes through the wire and tap the cardboard lightly so that the filings can move easily. They will arrange themselves in more or less distinct circles, as shown in Fig. 24, which is taken from a photograph.

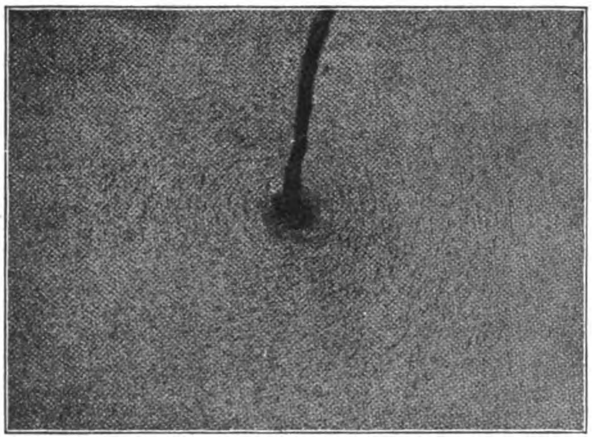


FIG. 24.

If the wire is threaded through two rows of holes in a cardboard so as to form a coil or helix and current is sent through the wire, filings scattered upon the cardboard will arrange themselves as shown in Fig. 25 in lines much like those about the bar magnet, showing that the magnetic fields about the separate wires have united to pass around a common path through the coil. Such a coil, sometimes called a solenoid, has most of the properties of a bar magnet. Careful experiments show that the magnetic force about a continuous current is exactly the same as the force about a magnet.

123. *If the presence of electricity produces a magnetic field, does the presence of a magnetic field produce electricity?*

The mere presence of a magnetic field around a conductor does not produce electricity, since that would imply the actual creation of energy, which is impossible. It is true, however, that the movement of a conductor across a magnetic field, or of a magnetic field across a conductor, always causes a tendency for current to flow in the conductor. If the conductor forms a closed or complete circuit, a current will flow in it.

124. *Is there any special name for such a tendency for current to flow?*

It is called an induced electro-motive force, or E.M.F.

125. *How can one study the induction of currents?*

Much can be learned by simple experiments with galvanometer and coil of wire.

126. *What is a galvanometer?*

The galvanometer is an instrument for detecting or measuring small currents. A convenient one may be made by wrapping a number of turns of wire around a pocket compass (say 40 turns of No. 24 cotton covered wire) and placing it level and so that the needle lies in the plane of the coil as suggested in Fig. 26. Such a crude instrument cannot compare with the expensive ones in laboratories, but it will do for some purposes.

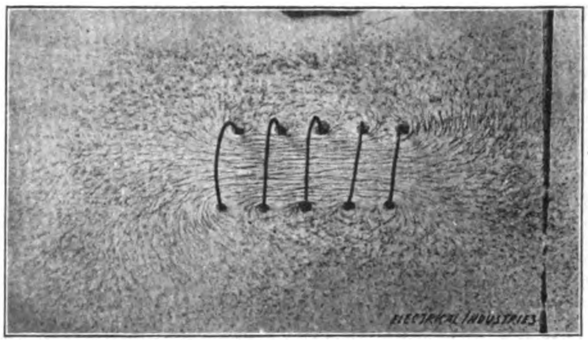


FIG. 25.

127. *How can induction be studied with galvanometer?*

Make a coil two or three inches in diameter with forty or more turns of insulated copper wire of any convenient size. Connect the ends of the coil with the terminal wires of a galvanometer as suggested in Fig. 26. Slip the coil quickly over the end of a magnetized screw-driver or any other magnet and the needle of the galvanometer will be thrown to one side, say to the right, and will then return to its former position. Move the coil quickly off the screwdriver and the needle will be thrown in the opposite direction, to the left. Twist the coil half way around and slip it over the end of the magnet and the needle is thrown to the left. Slip the coil clear over and off at the other end, and the needle is thrown in one direction at one end but in the opposite direction at the other end. Hold the coil still and move the screwdriver end into the coil, and the needle is moved in the same direction as when the coil was slipped over the same end. In this last experiment the galvanometer should be at least three feet away so the needle will not be affected magnetically by the motion of the screwdriver.

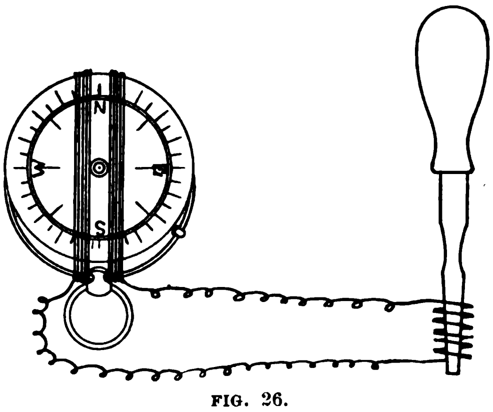


FIG. 26.

128. *How can one tell the direction of the induced current?*

By common consent it is agreed to consider the lines of force as coming out from the north-seeking pole of a magnet and as going into the south-pole. A convenient rule of thumb for determining the direction of induced E. M. F. or current is to hold the thumb and first and second fingers of the right hand at right angles to one another as suggested in Fig. 27. If the forefinger points in the direction of the lines of force, the thumb in the direction of the motion, the central finger will point in the direction of the induced current.

129. *How long does an induced current last?*

Only so long as the motion continues. The E. M. F. that causes the current is produced by the crossing or cutting of the lines of force, and is proportional to the rate of cutting.

130. *What determines the voltage or pressure of an induced current?*

The voltage equals the rate of cutting lines of force. It equals the product of the number of wires in the coil, the intensity of the magnetic field and the velocity of the motion. The E. M. F. is one volt when the product is 100,000,000 lines cut per second.

131. *Is the current from a dynamo caused in any such way as described in 126?*

The principle is the same, although it is developed in a different way. Instead of moving a coil back and forth, it is rotated between the poles of a magnet, as indicated in Fig. 28. If the coil is rotated in the direction of the hands of a clock, the E. M. F. in the wire at the left tends to send current toward the handle, while that in the other wire is in the opposite direction. When both wires are connected so as to form a closed circuit, current will flow around the circuit as indicated by the arrows. After the loop has passed a position midway between the two poles, the wires begin to cross the magnetic lines in the opposite direction and the E. M. F. is reversed. The current in the loop therefore changes direction also. If the two wires are connected only at one end and the other ends are brought out and connected with an outside circuit, current will flow in it also. The current obtained for such a loop would not flow continuously in one direction but would go first in one direction and then in the other, being known as an alternating current. By making the loop to consist of many turns of wire, the E. M. F. is increased proportionally.

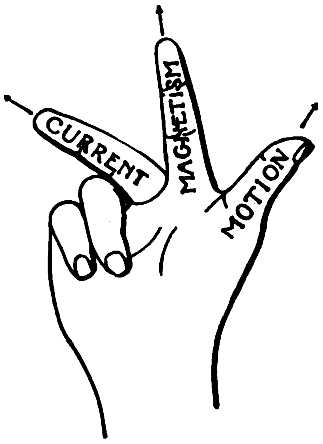


FIG. 27.

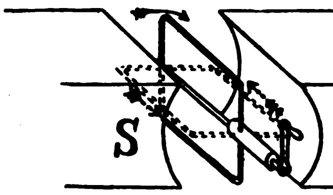


FIG. 28.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

QUEER WAYS OF LIGHTNING.

Editor Electrical Industries:—Lightning has recently paid my plant a visit and as lightning is always interesting I thought perhaps some of your readers might like to hear about it. We have a number of incandescent lamps here run on a series system and one of the circuit goes to a residence with an unusually high tower, situated on one of the highest points in the town. This tower is built of wood and covered with tin. The main building is a large two-story rock edifice with a shingled roof. Along the comb of the roof is a fancy iron railing or scroll work and on the top of the tower is a metal weather-vane. During a recent thunder storm, about eight o'clock in the morning, lightning struck this tower. The family was at home, and one of the young ladies was even up stairs at the time, but excepting a slight headache brought on probably more by the unusual excitement than by the shock, were unhurt. When called to examine my wires, etc., I found a whole in the roof of the tower about six inches in diameter, with the tin bent into it and the wood splintered, looking for all the world like some one had shot at it with an unusually large load of shot from the outside. About four feet below on another ledge of roofing, looking just like the first, though not quite so large, was another hole but with the splinters pointing out and the tin roofing bent up, as though made by a shot from the inside.

There was no sign of a path for the lightning between these holes, thought I searched diligently for a possible connection; and it seemed peculiar, too, that if the lightning was entering the building seeking a path to the ground, it should, after entering it, turn immediately and go back to the clouds, which the circumstances would seem to indicate that it did do. The tower is divided into three stories, and this of course was on the first. Down on the second story on the side immediately opposite to the two holes on the roofing of the first, the weather boarding was torn off and the wood shattered. The whole wall was forced at least two inches out of plumb. The tin around the window casing to prevent leakage from the rain showed signs of intense heat some of it having been melted. I searched faithfully for a connection from this floor to the two holes on the story above, but if the current came from that way, it left no visible path behind it. On the third story, with a floor and about two feet of wall between it and the shattered weather boarding above, the current again showed where it had been, and seemed to jump suddenly from one of the upright studdings in the wall to my electric light wire (which is a No. 12 B & S with underwriters' white fireproof insulation). The wire for about ten feet, when it came to a porcelain insulator, was melted and shattered into a thousand splinters, like a mashed piece of wood or bone; the inside of the insulation was charred and showed very evident signs of intense heat, and was ruptured and split till it would hardly hold together. The first two insulators were completely shattered, one of them so much so that only the blackened screw was left to show where it had been. The ten feet of white wire was soldered at the second insulator to No. 12 weatherproof wire and the current seemed to follow that to the next insulator which was so slightly split. The insulation on this wire was burned and charred to a cinder. The wire itself was not shattered like the first, though it, too, showed that it had been very hot, but had very mysteriously been converted into a hollow tube, a hole about the size of an ordinary pin having been made through its center its entire length. It was very brittle and could not be bent without breaking. Here the track of the current was lost again, though an iron rod which went down into one of the stone walls had evidently received some of it, as the wall had been pushed out on both sides of it, as though a dynamite cartridge had been exploded in it. So after replacing these parts with good wire and looking around for further damage without discovering anything, I supposed everything all right, but to be on the safe side tested the circuit with a magneto, when to my surprise I found it still open. Making a further test with the bell, I found the wire broken, but held together with the insulation at an insulator, at least 20 feet from the nearest visible sign of the current with no possible connection between except the wire itself. There was but one report heard and one flash seen.

Now the question with me is: Where did the lightning enter the building and where did it leave it? Or where did it go to? Was there only one, or several distinct strokes? If only one, as I would infer from the sound and the flash, how did it jump from one place to another as it did down below and how did it get through the two floors and walls to get down to the lower stories and back again to the second hole in the roof, where some of it at least so evidently went out? Some of the current too certainly followed the wires to the station and to ground, because I found the main fuse on the switchboard blown and the circuit broken. Possibly you or some of your readers can explain the course of the current and its direction. Yours respectfully,

Homer Starr, Supt.,
Gonzales E. L. & P. Co.

The Convention of the American Street Railway Association.

Upon their assembling in Winsor Hall, Montreal, on October 15, the delegates to the fourteenth annual convention of the American Street Railway Association, listened first to addresses of welcome by Mayor J. A. Villeneuve and Col. A. C. Stevenson. The address of the president, Mr. Joel Hurt, of Atlanta, Ga., pointed out the importance of the industry represented and its relation to the steam roads. Regarding this question he said:

"There are in operation today in the United States about 179,300 miles of steam roads, and about 13,500 miles of street railways. The passenger receipts on the steam roads the past year were $276,031,000. The gross receipts of street railways in the United States were between $125,000,000 and $140,000,000. The street railway mileage is about 7½ per cent of the steam railway mileage, and passenger receipts of street railways about 45 per cent of the passenger receipts of steam roads. The total capitalization, bonds and stocks of steam roads in the United States is about $11,000,000,000, and of the street railways about $1,300,000,000. The latter is about 11 per cent of the former, while the profits of the steam roads were $322,000,000, and on the street railways about $43,000,000, the latter being about 13½ per cent of the former. From these figures an idea may be gathered of the magnitude of the business.

"The companies will need to lend a mutual aid to each other through the national association for the purpose of defeating hostile legislation in national, state and municipal governments, and to conduct a work all along the line which will tend to implant in the minds of the patrons of the roads the fundamental idea that the public interest demands friendly legislation for transportation companies, since this will tend to enable the companies to furnish the best and most rapid transportation, while harmful legislation will tend to bring about the opposite result.

"The relation of street railroads to steam roads is growing more interesting, and in some localities even perplexing, until the question is now being asked, What will be the solution of the extension of electric lines which are cutting so rapidly into the business of the steam roads? A partial consideration of this question brings forth the inquiry—Will not the interests of these two systems of transportation force an amalgamation of the systems, having thereby the main lines connecting distant points, which will be operated into stations at convenient points in municipalities from which passengers will be transported over various street railway lines to their destination?

"The steam roads of the country are organized, the territory being subdivided into several sections for the purpose of promoting harmony and mutual protection. While it is true that street railways do not now come into competition with each other, except to a limited extent, yet it is a question if their interests do not demand an organization with sufficient strength and facilities to keep a constant watch over the business throughout the country. It is believed that the time has come when a larger revenue must be raised either upon the assessment plan or by increasing the membership dues."

The afternoon session opened with a paper by Mr. E. J. Wessels on the "Present Status of the Air Brake." This paper was a continuation of one on a similar subject read by the same author at the Atlanta convention. The improvements in this kind of brakes, their increased use and the greater willingness on the part of street railway men to consider an improved form of brake were mentioned together with a review of the need of better brakes on electric and cable cars. Upon the conclusion of the paper it was discussed by several members, who related numerous experiences with the air brake.

The committee on the "Feeder System" not having been notified was unprepared with a report and the question of street paving was called up for discussion. Mr. Seely reported a case where the contractor refused to fill his contract unless the company stopped its cars on that section. The company found this expensive and determined to pave the street themselves. Others reported no trouble in keeping the cars running while the paving was being done. Wednesday morning the president announced upon calling the meeting to order that the association would go into executive session. The first topic for discussion was the labor question taken up by Mr. Wyman and Gen. Jackson. A communication, with paper on "Transfers," from Mr. Baumhoff, of St. Louis, was read and the paper ordered printed.

At the afternoon session the report of the executive committee was read with the amended constitution and by-laws as proposed by the committee. The meeting then adjourned until 4:30 p.m., to enable the members to attend the reception at McGill University. Upon re-assembling the question of the deficit received attention, and after some discussion a committee on ways and means as proposed by Mr. Harrison, was appointed by the chair to provide some way of raising the required amount. Upon motion of Mr. Littell a committee of seven was appointed to present nominations and recommend a place for the next meeting. The meeting then adjourned until 10 a.m. the following morning.

Upon assembling in the hall on Thursday morning the president announced the names of the members of the committees on ways and means, as follows: R. B. Harrison, H. M. Littell, T. H. McLain, W. Y. Soper, H. M. Watson, Charles Odell, Charles Green, E. C. Goodrich, T. C. Pennington and John N. Akarman. And on nomination: C. D. Wyman, Milwaukee; Charles S. Sergeant, Boston; John B. McClary, Birmingham; W. J. Thompson, Camden; Edward Lusher, Montreal; John A. Seely, New York; Henry Scullin, St. Louis. There was then read by the secretary a communication from Mr. W. J. Hammer, chairman of committee on standard Rules for Electrical Construction and Operation of the National Electric Light Association, soliciting the co-operation of the American Street Railway Association in this work and asking that a representative be appointed to meet the joint committee of the various electrical and allied associations. The matter was placed in the hands of the executive committee.

The paper by Mr. Brown on "Ties and Poles" was then read and discussed. Mr. Seely then offered the following resolution which was adopted:

> Whereas, It is the purpose of the National Electric Light Association to hold in New York city next spring at its annual convention, a comprehensive exhibit of modern electrical inventions and applications depending on the use of central station and power house current, with the object of increasing popular interest in electric lighting and allied arts, and
>
> Whereas, It is the desire of the American Street Railway Association to promote on the part of the public, particularly in all large cities, a fuller and more intelligent appreciation of the great benefits that accrue from electric light, heat, locomotion and other modern triumphs of civilization.
>
> *Resolved:* That this Association hereby expresses its cordial sympathy with and approval of this plan for the furtherance of electrical development, and for the enlargement of the sphere with which electricity is to perform its beneficent work.

In support of this resolution Mr. Davis, of Williamsport, said: The National Electric Light Association intends to hold an exhibition in connection with its next annual meeting to be held in New York City, in May or June of next year. The exhibition will be held under the auspices of the National Electric Light Association, but is to be given in the name of a company formed specially for that purpose, with a sufficient capital to make the exhibit of far more than ordinary interest. I understand that the object is to include in that exposition electrical appliances applicable to street railways as well as appliances applicable to the electric lighting business. The resolution is simply intended to interest the members of this association in that exhibition.

At the afternoon session Mr. Russell B. Harrison, chairman of the ways and means committee, made read the report, which, although warmly discussed, accomplished the main object for which it was appointed and resulted in placing the association practically out of debt. The subject of admitting supply men to associate membership was included in the report but was laid on the table with the report of the committee. The committee on sand and salt submitted a brief report that was accepted.

The nominating committee presented the following recommendations for officers for the ensuing year:

For president, H. M. Littell, Brooklyn. N. Y.; first vice-president, Granville C. Cunningham, Montreal; second vice-president, William H. Jackson, Nashville, Tenn.; third vice-president, J. Willard Morgan, Camden, N. J.; secretary and treasury, T. C. Pennington, Chicago, Ill.; executive committee: Joel Hart, Atlanta, Ga.; Prentiss Cummings Boston, Mass.; C. G. Goodrich, St. Paul, Minn.; A. Markel, Hazelton, Pa.; W. F. Kelly, Columbus, O.; place of next annual meeting, St. Louis, Mo. The secretary upon instruction cast a ballot and the officers were declared elected.

The first subject before the convention at Friday's session was "Furnishing Free Music and Other Entertainments by Street Railway Companies to the Public." Mr. J. F. McElroy read a paper on electric heaters for street cars. Resolutions of thanks were passed expressing the appreciation of the members to the citizens of Montreal and the Montreal Street Railway Co. for the hospitalities and courtesies extended. The new president and secretary were escorted to the platform by a committee appointed. In a few words they thanked the association and pledged to work for its interests. The convention then adjourned to the third Tuesday in October, 1896.

CONVENTION NOTES.

The Berlin Iron Bridge Co., of East Berlin, Conn., was represented at the convention by Mr. Albert Bernstein.

The street railway exhibits were displayed in Victoria Rink, which contained a large and varied line of apparatus and supplies.

The Western Electric Co. was represented by Mr. J. Wiley, who is well acquainted with the trade and the goods best suited to their wants.

The Jewell Belting Co., of Hartford, Conn., made an exhibit of their new pulley covering, belting, etc. Mr. C. L. Tolles represented the company.

The Adams & Westlake Co., Chicago, had an extensive exhibit of their railway specialties. Mr. L. A. Gray and Mr. F. B. Jones were in attendance.

The Crane Company, Chicago, made an exhibit of their gate, globe and safety valves. This was in charge of Mr. G. A. Hurd, the company's representative.

The Safety Insulated Wire & Cable Co. had its interests well cared for by Mr. H. T. Richards, who has an extensive acquaintance in street railway circles.

The Chicago Insulated Wire Co. had an exhibit of bare and insulated wire, which was in charge of Mr. George S. Whyte, who distributed appropriate souvenirs to delegates.

The Columbia Incandescent Lamp Co., St. Louis, was represented by its president, Mr. J. H. Rhotehamel. The interests of the Columbia lamp, it is needless to say, were well taken care of.

The McGuire Manufacturing Co , Chicago, made an exhibit of its well-known trucks and car heaters. Mr. W. J. Cooke, vice-president, and Mr. J. A. Hanna, of the New York office, were present.

Chas. A. Schieren & Co , the well-known belt manufacturers had a souvenir for their friends in the shape of a belted match box. Mr. Charles A. Schieren, Jr., was present in the interest of the company.

The Chapman Valve Mfg. Co., of Indian Orchard, Mass., had an exhibit in charge of Mr. Ross at the exhibition hall, but referred especially to their working exhibits at different power house, in Montreal.

The Allerton Lubricating Co., Chicago, manufacturers of all kinds of lubricants, was represented by Mr. Charles J. Seeber, who met many old customers and found several new ones among the railway men.

The Standard Paint Co ,had a very fine exhibit of the line of insulating materials manufactured. The general sales agent, Mr F. S. De Ronde, and Mr. J. C. Shamwald, manager of the Chicago, office were present.

The India Rubber & Gutta Percha Insulating Co , the makers of Habirshaw wire, showed samples of both aerial and underground wires and cables. Mr. J. W. Godfrey and Mr. F. W. Harrington were in attendance.

Baker & Co.,of Newark, N. J.,the platinum refiners,were represented by Mr. C. O. Baker, Jr., who has been a familiar figure at many of the electric light conventions and not unknown at street railway conventions.

The Fuel Economizer Co., of Matteawan, N. Y., had a working exhibit at the power house of the Montreal Street Railway Co. Messrs. A. H. Blackburn, Wm. Downs and Stanley Green were in attendance in the interests of the company.

Eugene Munsell & Co. made a very fine exhibit of mica in both the raw state and as prepared for the use of railway companies. The variety shown in the exhibit made it especially attractive to street railway men. Pure mica is looked upon as one of the best insulators, and for commutators and armature cores is without a rival.

Mica Insulator Company, 218 Water St.; New York, had an extensive exhibit of micanite insulating forms, including rheostat box linings, taper rings, commutotor segments, armature troughs, tubes, bushings, washers, cloth and plates.

The Babcock & Wilcox Co. displayed a number of samples of the steel forgings used in the construction of the Babcock & Wilcox boiler. Mr. Wm. T. Bonner, manager of the Canadian department was present to represent the interests of the company.

The Consolidated Car Heating Co. had a number of heaters on exhibition. Some were installed, others in section, to show the operation and construction. There were three representatives of the company present, H. U. Ranson, J. F. McElroy and W. P. Cosper.

The Forest City Electrical Works, of Cleveland, Ohio, had a display of the well known rolled-drop commutator segments for motors and generators. Messrs. Cleveland and Dolph were present and had with them copies of the new catalogue of the line of goods manufactured.

The John A. Roebling's Sons Co., of Trenton, N. J., had a very attractive exhibit of wire, cables, and their well-known lines of street railway goods. Messrs H. L. Shippey, New York; M. R. Cockey, Trenton, and G. C. Bailey, Chicago, were present. Wire souvenirs were distributed.

The American Electrical Works of Providence called especial attention, by circulars and an exhibit, to their new rail bond, and also to their wires and cables for railway service. Mr. W. A. Hathaway, Mr. P. C. Ackerman, Mr. F. E. Donohoe and Mr. John Carroll were present in the interests of the company.

The Phillips Insulated Wire Co. was represented by Mr. H. C. Adams, jr., of New York, who had with him samples of the variety of wires and cables made by the company. The factory of the company at Pawtucket, R. I., is reported very busy filling orders for their well-known brands of wire.

The Standard Underground Cable Co. was represented by Mr. Geo. L. Wiley of New York. Samples of wire and cable, such as are largely used by street railway companies, were exhibited. The samples were all the more interesting from the fact of their having been cut from cables installed by the company on some of the largest systems in the country.

The Walker Manufacturing Co of Cleveland, Ohio, had a very handsome exhibit. The space occupied was handsomely arranged and the ralway apparatus was of an interesting character. A Dorn & Dutton truck was shown equipped with two 25 horse power motors and a Peckham truck was equipped with two 50 horse power motors. Switchboard panels, controllers, coils, etc., etc., were exhibited. The representatives of the company present were: Mr. H. M. Harding, Mr. R. H. Baylis and Mr. C. W. Kent.

The Okonite Co., ltd., had a novelty in tape which attracted attention. The tape was packed in round tin boxes of two colors, red and white, containing one ounce of tape. It has been found that the lineman, in using tape put up in the usual way, uses what he needs and throws the balance away or leaves it in such a way that it soon becomes unfit for use. These boxes contain all that is required for any ordinary repair, and if there is any left it will be all right for future use if placed in the box. The box is small, about the size of a watch case; can be carried conveniently in the pocket, and seems to be just the thing. Mr. W. L. Candee found that street railway men were well pleased with it. For riders of the wheel it is without a superior for a temporary repair.

The Westinghouse Electric & Mfg. Co. was well represented by Mr. George H. Lewars, assistant secretary, Mr. Albert Schmid, general superintendent and Messrs. E N. Sanderson, J. A. Rutherford, R. S. Brown, B. F. Stewart, H. A. Cragin, E. H. Heinrichs and G. E. Gordon. The company's headquarters were at the Queen's Hotel where it had a large parlor and reception rooms for visitors. Attention was called to the Westinghouse motors in use on the lines of the Montreal Street Railway Co., which was considered the best kind of an exhibit for practical men. For this reason it was not considered necessary to make an exhibit at exhibition hall. The representatives, however, had on hand a good supply of railway literature.

The Hogan Boiler Co., of Middletown, N. Y., exhibited some of the principal parts of the Hogan water tube boiler, among which was the mechanical steam extractor, by means of which the passage of the entrained water with the steam is prevented. The feed water indicator shows the manner of distributing the feed water as it enters the boiler, and the precipitation of all foreign matter in the lower drums not exposed to heat, thus preventing the formation of scale on the heating surfaces. The boiler is said to evaporate from 8 to 11 pounds of water from one pound of anthracite buckwheat and good bituminous coals. With coal at three dollars a ton, a yearly saving of twenty per cent can be saved by this efficient evaporation. The general design of the boiler, as illustrated at the exhibit, differs materially from those in common use. The design is, however, simple, and the boiler occupies a small amount of floor space in proportion to its capacity. Several photographs of large boiler plants using the Hogan boiler were exhibited. It combines steam separator, water heater and purifier. Mr. J. J. Hogan, president of the company, was in attendance.

The General Electric Co. had an exhibit in one of the stores in Windsor Hotel bldg. Current was obtained from the lines of the Montreal St. Ry., and the exhibit in many ways rendered attractive. In the center of the room a Peckham truck, equipped with G. E. 800 motors and electric brakes, was shown in operation. Motors of different sizes were exhibited, together with samples of overhead and station material and supplies. The new types of controllers, especially the larger sizes, attracted considerable attention. Incandescent lamps, by means of several unique devices, were well advertised. Among the representatives present were Messrs. Kimball, Saltonstall, Pierce and Hodges, of Boston, Messrs. Potter, Tandy and Haywood of Schenectady, Messrs. Beach, Baylor, Bushnell and Morris, of New York, Mr. Crowley, of Philadelphia, Mr. Todd, of Baltimore, and Mr. Rosenthal, of St. Louis.

THE ELECTRIC RAILWAY.

EXTENSIONS AND IMPROVEMENTS.

Hoosick Falls, N. Y.—Hoosick Railway Co. is contemplating an extension to Bennington, Vt., early the coming season.

Catskill, N. Y.—A road from Catskill to Windham to be operated by electricity is contemplated and the proposed route has been mapped out.

Oswego, N. Y.—The Oswego Street Railway Co., has in contemplation a number of improvements. It now leases its power for electric lines.

Mechanicsville, N. Y.—It is reported that the street railway company contemplates changing its lines to electric, and work will be commenced at once.

Steubenville, O.—The Steubenville Traction Co. will rebuild its lines in the spring and construct new overhead line. A new car barn is contemplated and also new cars.

Orange, N. J.—Suburban Traction Co., Watson Whittlesey, receiver, will build soon one mile new track and in the near future a new car house and power plant. Power is now obtained from the electric light plant.

Lima, Ohio.—The Lima Electric Railway Co. contemplates two extensions of its lines, one of about 4,000 feet to pleasure grounds and another of about 6,500 feet to the Lutheran college. The company has General Electric apparatus.

Chicago, Ill.—The Chicago City Railway Co. is changing the horse car line on Indiana Ave to electric. Although the consent of property owners for the entire distance has not been secured, the company are so sure of final success that they will now put up as much of the line as the right of way has been secured.

McKeesport, Pa.—McKeesport. Duquesne & Wilmerding Ry. Co., is extending its lines to Homestead, where it will connect with Pittsburg lines. This road now connects with Pittsburg line at Wilmerding and the new extension now being made will give it further facilities for accommodating the through travel.

PERSONAL.

Mr. C. F. Scott, the well-known electrical engineer of the Westinghouse company, was married on the 15th instant to Miss Clarke of Columbus, O. Mr and Mrs. Scott have the congratulations and best wishes of a host of friends, with whom Electrical Industries joins.

Mr. H. M. Littell, the new president of the American Street Railway Association, has been prominently connected with a number of the large street railway companies and formerly with the steam systems At St Paul in 1883 to 1885, Cincinnati in 1888, New Orleans 1893, and since July 1st of the present year has been president and general manager of the Atlantic Ave. Railroad Co., Brooklyn.

Mr. T. C. Pennington, the newly elected secretary of the American Street Railway Association, has been connected with the Chicago City Railway Co. for a long period, having entered the employ of the company in 1881, and is now holding the position of secretary and treasurer. His knowledge of the street railway business will be beneficial to the association, which should be congratulated on having secured so able a man for the position.

NEW BOOKS.

The Practical Application of Dynamo Electric Machinery. By Carl K. MacFadden and W. D. Ray. New edition, 1895; Chicago: Laird & Lee. Cloth, flexible covers; 170 pages, numerous illustrations; price $1.00.

This new edition possesses all the merit of the former edition from which it differs in minor matters of make-up alone. Several full page plates have also been added, increasing the attractiveness of the volume. To most readers on subjects of this kind, the value of any book depends upon the concise and comprehensive manner in which it is treated. To them this book is commended as presenting in a concise and readable manner "the practical application of dynamo electric machinery," a subject of great interest both to those directly connected with the industry and to the general reader. Having been written by practical men thoroughly conversant with the demand of practical men, the book has met and will continue to meet the wants of a large class of readers. The rapidly increasing use of electrical machinery has required many to post themselves regarding this class of apparatus and to do this one must study the construction as well as the operation of the machines,

Electricity for Everybody; Its Nature and Uses Explained. By Philip Atkinson, New York, 1895. The Century Co. 240 pages, numerous illustrations; price $1.00.

This book has been written to supply a demand from the general public for information regarding electricity and the variety of apparatus used in its application. It has therefore been written in a plain and comprehensive manner such as will be readily understood by those who have no previous knowledge of electricity. No attempt has been made to give a history of electricity and its application, but the present knowledge and improved appliances are given. The general reader will find no trouble in understanding the subject as here presented, all abstruse technical matter being omitted and where it is necessary to use technical words or phrases their meaning is defined. Numerous cuts are used to illustrate electrical phenomena and the apparatus in use. The natural phenomena and many simple experiments are described, the apparatus used to produce electricity and those employed in its application are described. The construction of the dynamo, that of the arc lamp, and how it produces light, etc., are explained. The volume is published in an attractive style. Good paper and excellent press work, together with skill and taste in the make up have produced a very attractive book.

Alternating Electric Currents. By Edwin J. Houston and A. E. Kennelly. New York, 1895: The W. J. Johnston Co. 225 pages; 77 illustrations; cloth; price $1.00.

This is the first of ten volumes to be issued in the electrotechnical series which is intended to cover the subjects of most interest in this department. Each volume is complete in itself but is issued in similar style and for the same class of readers as the remainder of the series. In the first chapter, the principles of alternating currents are explained with reference to mechanical analogies, and the following chapter takes up the subject of alternating electro-motive forces and currents, the phenomena of impedances and reactances being very clearly and simply treated. Next are five chapters devoted respectively to single phase alternators, the generation of alternating current in central stations, transformers, simple alternating motors, and incandescent and arc lamps. In these chapters will be found such a description of the working of an alternating central station, the operation of generators, motors, transformers and lamps generally, as will enable non technical readers to obtain a comprehensive knowledge of the subject. The remaining chapters consider the subject of multiphase currents and motors, the principles of which are explained in simple language.

Fourth Report of the Bureau of Mines, Ontario. Printed by order of the Legislative Assembly of Ontario, Toronto, 1895. The press of Warwick Bros. & Rutter. For distribution.

This report, presented by the commissioner of crownlands, contains much valuable and interesting matter. He has not only presented the facts regarding the work of the commission for the year but has also presented a report covering the growth and development of the newer sections of the country, particularly of the mining districts. The report of the Bureau of Mines covers not only the mineral character of the country but describes the fauna and flora of the various sections covered by the report. The opening section deals with the mineral industry of Ontario, the various movements and conditions which have affected it and statistics regarding the production for the year. This part of the volume is greatly enhanced by a number of large maps of the districts, showing the exact formation and position of the different rock strata. The descriptions of the explorations made during the year are particularly interesting. The recent discoveries and improvements in methods of manufacture are touched upon and in some cases described at some length. The Report covers also the investigation of the mining accidents occurring during the year. The matter has been well prepared and will be found of interest to those engaged in the mining industry or who find pleasure the in study of the subject.

A Guide to Systematic Readings in the Encyclopædia Britannica. By James Baldwin, Ph. D., 1895. Chicago and New York. The Werner Company. Library binding; 316 pages; price $2.00.

The Encyclopædia Britannica rests upon many library shelves but to the owners it is like a sealed chest, impenetrable. The information is there, but the reader without a guide gets hopelessly lost in the mass of knowledge which he finds. This guide, which has been prepared by Dr. Baldwin, is a key that unlocks the chest and opens in a systematic arrangement the contents of the encyclopædia. No matter in what way you desire to read or study, what subject you wish to investigate, or what course of study you may wish to enter upon you, will find it marked out for you in this admirable guide. In order that the guide may be useful to all it has been arranged for the young people, the general readers and the business or professional men. Courses of reading for the boys and girls with suggestions and encouragements are given in the first chapter. In Chapter II the student and popular reader finds courses of reading on almost every subject marked out. The larger part of the guide is adapted for business people. Every profession has outlined the subjects relative to that vocation, which are of the greatest interest. Thus the engineer, the lawyer, the machinist, the farmer, etc., has prepared for him courses of reading in the Encyclopædia Britannica on the industry with which he is connected. It should go with every Encyclopædia Britannica.

TRADE PUBLICATIONS.

The recent catalogue of the Emerson Electric Mfg. Co., of St. Louis, Mo., presents a great variety of electrical supplies and apparatus manufacturd by that company. Cuts, descriptions and price lists of push buttons, switches, cut-outs, transformers and many special appliances are shown. New designs are noticeable in many of the specialties.

"The boys have something to say about Dixon's pure flake graphite that is worth reading" in a pamphlet recently issued by the Joseph Dixon Crucible Co., of Jersey City, N. J. What they say shows not only how well it is liked by the people who use it, but also how widely it is used. The graphite is obtained from the mines of the company at Ticonderoga, N. Y., and is prepared in different forms according to the different uses to which it is put. The pamphlet gives also other information of interest to those who have the care of machinery.

A pamplet of over sixty pages issued gratis by the Manhattan Electrical Supply Co., presents information regarding telephone systems and apparatus. The various parts of the telephone system are described, and in the subsequent pages illustrated with price lists. The telephone instruments and accessories listed are sufficiently numerous to meet the wants of a variety of customers. Diagrams of private lines, exchange systems and telephones on the "intercommunication system" are given with descriptions. There is also an extensive line of electrical supplies listed which is, however, but a supplement to the extensive general catalogue issued by this company.

A very neat and attractive catalogue was recently distributed by the Buckeye Electric Co., of Cleveland, Ohio. The designs for the unique illustrations are quite original and serve the double purpose of illustrating the many uses of the electric incandescent lamp and rendering the pages interesting to the eye of the reader. Besides these illustrations each page contains a cut of one style of the well known Buckeye lamp printed in an ink of another color. The standard styles of lamps are shown all on the same scale, so that the exact size as well as appearance of the lamps is noted. The catalogue is an interesting study and shows most excellent taste in its make up. It is bound in board fastened with silk cord.

A complete catalogue of the "Wood" systems of electrical machinery and apparatus for light and power manufactured by the Fort Wayne Electric Corporation of Fort Wayne. Ind., has recently been received. It is bound in a handsomely embossed cover. the design being especially appropriate and shows the marvelous advancement made in electric arc lighting by views of the first and latest types of arc lighting dynamos. The elegant cover suggests contents equally attractive and so the reader finds them. The text has been carefully prepared and the cuts and illustrations show skillful execution of both design and engraving. Pains have been taken to illustrate the more complicated parts of the apparatus and show the construction and arrangement of parts. The catalogue is a valuable addition to a library of electro technical literature.

The Walker Manufacturing Co. of Cleveland, O., has recently issued catalogues 10, 11 and 12 which are devoted respectively to street railway equipments and interurban and elevated railway equipments, incandescent machines and power generators. The first presents views of the equipment which are explained by the accompanying text and also numerous views of cars on street railways equipped by the Walker system of electric traction. Catalogue No. 11 illustrates and describes the systems of incandescent lighting and the generation of power. The dynamos are illustrated in detail and the various appliances used in central station service are shown. Catalogue No. 12 is especially interesting at this time when electric roads are binding neighboring cities together. The half tone illustrations show equipments furnished to several important roads during the past year. The motors used on these roads which run their cars up to 40 miles an hour, are very strongly constructed, being designed especially for this class of service.

A large and complete catalogue of the Correspondence School of Technology, Cleveland, O., has been received. It shows the plan of the school, course and method of instruction, character of students desired, together with sample lessons in several departments. The courses are listed as follows: 1. Electrical engineering; 2. Steam engineering; 3. Bridge, roof and iron structures; 4. Surveying and road construction; 5. Mechanical engineering; 6. Hydraulic engineering, and 7. Higher mathematics. Each course is divided into two main divisions; the one is termed "allied studies," pursued in preparation for the second which is the special branch of engineering desired The catalogue answers almost any question that might be asked regarding the school. There are appended a number of letters from graduate students speaking in the highest terms of the benefits received from their course of study. A full page plate contains portraits of a number of the instructors, a short biographical sketch of whom follows. Each department of engineering has a specialist at its head who has had a thorough practical experience.

A very handsome little pamphlet has been issued by the Ball Engine Co., of Erie, Pa., presenting the improved horizontal and vertical Ball engines. One of the first companies to recognize the demand for high speed engines for operating electric generating machinery the company has now a long experience in the construction of engines for that purpose. This pamphlet shows the engines built for operating electric generators by belt and direct connection. The views are excellent engravings reproduced by the photo engraving process from the original photographs. They are remarkably clear and show the details of the engine with great exactness. The engines include both simple and compound, horizontal and vertical engines. Views show engines directly connected to generators of almost every American make It is a handsome thing, executed with great care and will undoubtedly be preserved as a record of the advancement made in the construction of power-producing machinery. As this is a handsome product of the printer's art, so is the Ball engine of the engine builders, as it is found in engine-rooms in nearly every state in the Union.

A very complete catalogue has recently been received of the Eclipse high-speed automatic steam engines issued by the builders, the Frick Company, engineers, of Waynesboro, Pa. Views in the shops with plan and description of the same is presented in the introduction. The various parts of this engine is described and illustrated in detail and the many points of advantage clearly explained. The operation of the governor, values, etc., is illustrated by diagrams, and in the engine as erected, outline sectional drawings show the arrangement of parts. The engine is presented in a most excellent manner to the trade. Engineers will find the pamphlet a profitable study. While in the design of the engine, close regulation, economy and durability have been sought, the neat and symmetrical appearance of the engine was not overlooked. The engine, as shown in the numerous engravings, has a most favorable appearance, which implies strength without a suggestion of clumsiness. While all parts are well protected, the working parts are easily accessible. Cross and tandem compound, condensing and non condensing, for belting or direct connection, and in the smaller sizes vertical engines are shown in the illustrations. The Frick boilers and refrigerating machinery also receive some attention.

BUSINESS NOTES.

The New York and Ohio Company, Warren, O., report business most excellent with the outlook good. Mr. W. D. Packard, of the company, was in the city a few days last month.

The Link Belt Machinery Co., Chicago, recently sent out to its many friends a neatly engraved invitation to inspect the electric mining plant of the Essen Coal Co., at Federal, Pa., installed by them. This is said to be the most extensive electric coal mining plant in the world and would well repay a visit.

Charles Wirt, Ludlow and 31st Sts., Philadelphia, Pa., has issued a catalogue of Wirt brushes, which contains practical information interesting to engineers.

Mr. Wilfred H. Fleming, 393 Pearl St., New York, is in receipt of many complimentary letters from superintendents and engineers, who are using his woven wire dynamo brush. They speak of the durability of the brush, the good condition of the commutator and the little attention required by the brushes.

The Dickinson Electric Supply Co., 150 Nassau St., New York, is carrying a stock of lamps, push buttons and supplies, giving special attention to the incandescent lamp trade. Mr. H. H. Dickinson is president of the company, A. S. Goodacre, treasurer and Henry S. Rilter secretary and general manager.

The American Electric Fuse Co., R. 210, 87 Washington St., Chicago, is manufacturing and placing before the trade the American connector for joining electric conductors. It is said to be one of the simplest and easiest joints made. Its cost is little, the joint is guaranteed to be air tight and it does not pull apart. A circular recently issued gives illustrations of the joint.

The Ft. Wayne Electric Corporation removes its Chicago offices to 620 to 625 Marquette Bldg., Nov. 1st. The new offices will be large and commodious and fitted up in the most handsome and elaborate manner possible. Mr. Chas. A. Munson, the Chicago manager of the company, believes that the change will be a most advantageous one for carrying on the business connected with his branch.

The American Circular Loom Co., of Boston, Mass., has opened an office for the control of western business, at 1114 Marquette Building, under the management of Mr A. D. Chandler. They report the outlook for their line of flexible conduit very encouraging, and would be pleased to see their friends and customers at any time. Mr. H. H. Brooks, the manager of the company, will spend the winter in this city.

The American Blower Company succeeds the Huyett & Smith Mfg. Co., of Detroit, which has built up an extensive trade in exhaust and blower fans and similar goods. It is really but a change of name which was considered advisable, since both Mr. Huyett and Mr. Smith were not now connected with the company. The officers of the company, are president, D. M. Ferry; vice-president, A. E. F. White, and secretary and treasurer, James Inglis.

The Electric Appliance Co., 242 Madison St., Chicago, has a special method of lighting factories, work rooms, etc., by the inverted arc system, which has been tried in many New England factories with great success. The Uptor inverted arc lamp enclosed in a large reflector throws the light upon the whitewashed ceiling from which it is reflected in all directions. The dark shadows disappear and a milder light more uniform in character is obtained.

The Elliott Lincoln Electric Co., Cleveland, was succeeded last month by the E. & C. Electric Co ,the new officers being as follows: President and treasurer, J. E. Crawford; vice-president, S. K. Elliott; secretary, W. A. Crawford; electrical engineer, C. E. F. Ahlm; general manager, G. B. Elliott The new corporation will settle all matters pertaining to the old company. The company announces that it will continue to manufacture slow speed multipolar motors and dynamos, its aim being to produce machines of the highest class.

The Electric Appliance Company, Chicago, has recently branched out and now occupies the entire building where it has heretofore had its offices and storerooms. The second floor is occupied by offices, while the ground floor will be used for store and exhibition room. Mr. W. W. Low, the president of the company, will retain his office on the first floor, while Mr. T. I. Stacey will have his office on the second floor. The building has four floors, each having a floor space of about 5,000 square feet, or a total of 20,000. This new move on the part of the company gives it greatly increased facilities in every department.

The Metropolitan Electric Co., 186-188 Fifth Ave., Chicago, has secured the general western agency for the J. Grant High & Co. special ties. These specialties are well known to the trade, and consist of switches, switchboards, etc , and it is needless to say the sales will be pushed throughout the west A complete descriptive catalogue is sent on application. The other specialties handled in the west by the Metroplitan Company are meeting with most excellent endorsement and ready sales in the west. N. I. R. wire meets with an increasing demand, while Metropolitan lamps and P. & B. paint are being ordered by old customers, and many new ones added to the list.

The Walker Manufacturing Co., Cleveland, Ohio, has just made arrangements for the sale of its electric railway equipments in Europe. MM. La Blanc and De La Briere, representatives of French capitalists visited Cleveland for the purpose of completing the arrangements. Both these gentlemen are experienced engineers. M. La Blanc was formerly electrical engineer for the European General Electric Co. They believe that they can buy American machinery and pay the duty on it and then compete on very advantageous terms with foreign manufacturers. It is reported that the syndicate represented by the above gentlemen has options on a number of important horse roads of Europe, which it is the intention to equip with electrical machinery.

The General Electric Company is about to install a monocyclic system in Salt Lake City, the distribution being made on the three wire secondary method from large transformers. Most of the lighting will be confined to a space covering about six blocks, and, as the blocks in Salt Lake City are 800 feet square, the territory covered is somewhat large. A branch line will run from one corner of the district for about a mile along the best residential street, while another line will run out from another corner of the district for about 1,500 feet to the county and city building. These lines will be gradually extended over other parts of the residential district as soon as the demand for such an extension arises. The station will be located on the railroad track 3,000 feet from the nearest side of the rectangular district of six blocks and 4,800 feet from the farthest side.

The generating plant will consist of two 150 K. W. 2,000 volt monocyclic alternators, belted directly to two Buckeye engines. As the larger blocks are more or less open, the center space being occupied by stores, barns, etc., room is thus afforded for the pole lines for the secondary wires around the inside of the block. From these service wires will be run into the rear of the buildings. The plans contemplate the installation of two 3-wire transformers to each block, one on each side of this interior court and the three-wire secondaries running around the court will be directly supplied from these transformers. As the number of lights in the block is increased the transformer equipment will be expanded. For lighting the residential districts from the branch lines the usual course of using small transformers will be followed bunching them as far as possible. Motors are to be connected at once as required, the balance wire being introduced only for motor work. The monocyclic system was selected chiefly on account of the facilities it offers for the economical operation of motors, and the fact that it allows of a practical solution of the day load difficulty.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED—An electric railway company having recently completed a new power plant and about to furnish power for lighting and manufacturing purposes, desires to secure the services of a reliable and experienced mechanical and electrical man; one who is competent to do wiring, install and set up motors, and, in fact, any work in that line. Address Electric Railway Manager, care Electrical Industries, Chicago.

WANTED—Young man wishes situation in an electric light plant. Has had experience with dynamos and engines and is at present engineer of a large plant. Address Engineer, care Electrical Industries, Chicago.

WANTED—Position as superintendent of a central station by a mechanical and electrical engineer with eight years' experience, and a thorough commercial knowledge of the business. Address Competent, care Electrical Industries, Chicago.

WANTED—Position wanted as superintendent by a practical and experienced central station man, having been in charge and understanding the different departments and leading systems of lighting; also the economical management of steam plants. First-class recommendations from responsible lighting companies. Address Superintendent, care Electrical Industries, Chicago.

WANTED—Position with street railway as manager, superintendent or electrician. At present electrical engineer of a forty car system. Experienced in construction and maintenance of street railways and power houses. Can furnish the best of references as manager, superintendent, etc. Address K. H. S., Electrical Industries.

A new process for the manufacture of a standard line of goods has been successfully tried by the inventor, who has received orders far in excess of the capacity of his shop. He desires a man with means to take hold of the business. Parties desiring to investigate may be placed in communication by addressing this office.

WOVEN WIRE BRUSH.

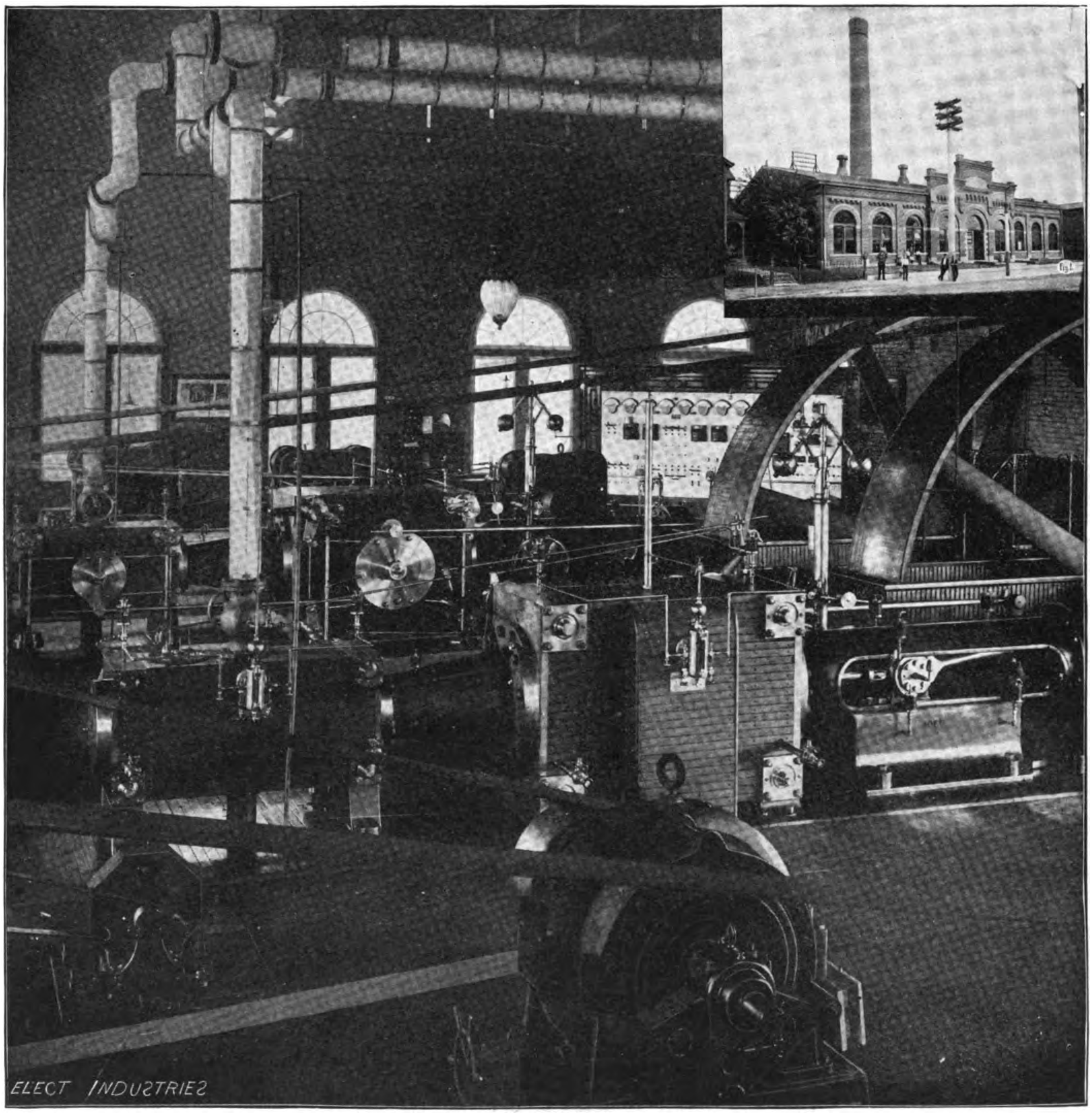
The Belknap Motor Co., of Portland, Maine, are the patentees and manufacturers of the best woven wire commutator brush on the market.

ELECTRICAL INDUSTRIES.

Vol. VI. CHICAGO. December, 1895. NEW YORK. No. 12.

The Lighting of the City of Hamilton, Ohio.

In undertaking the construction and operation of a municipal lighting plant, the city of Hamilton was not unguided by past experiences. The city water works, built in 1884, and the city gas works, built in 1889, have proven so satisfactory to the citizens that they readily voted for the expenditure of $100,000, to add an electric lighting plant to the city's possessions.



FIGS. 1 AND 2.—THE LIGHTING OF THE CITY OF HAMILTON, OHIO.

At the outset it was decided that, while primarily intended for lighting the streets and public buildings of the city, the plant should be so designed as to be capable of supplying electricity for private use—for both lighting and power. Thus the equipment naturally divided itself into

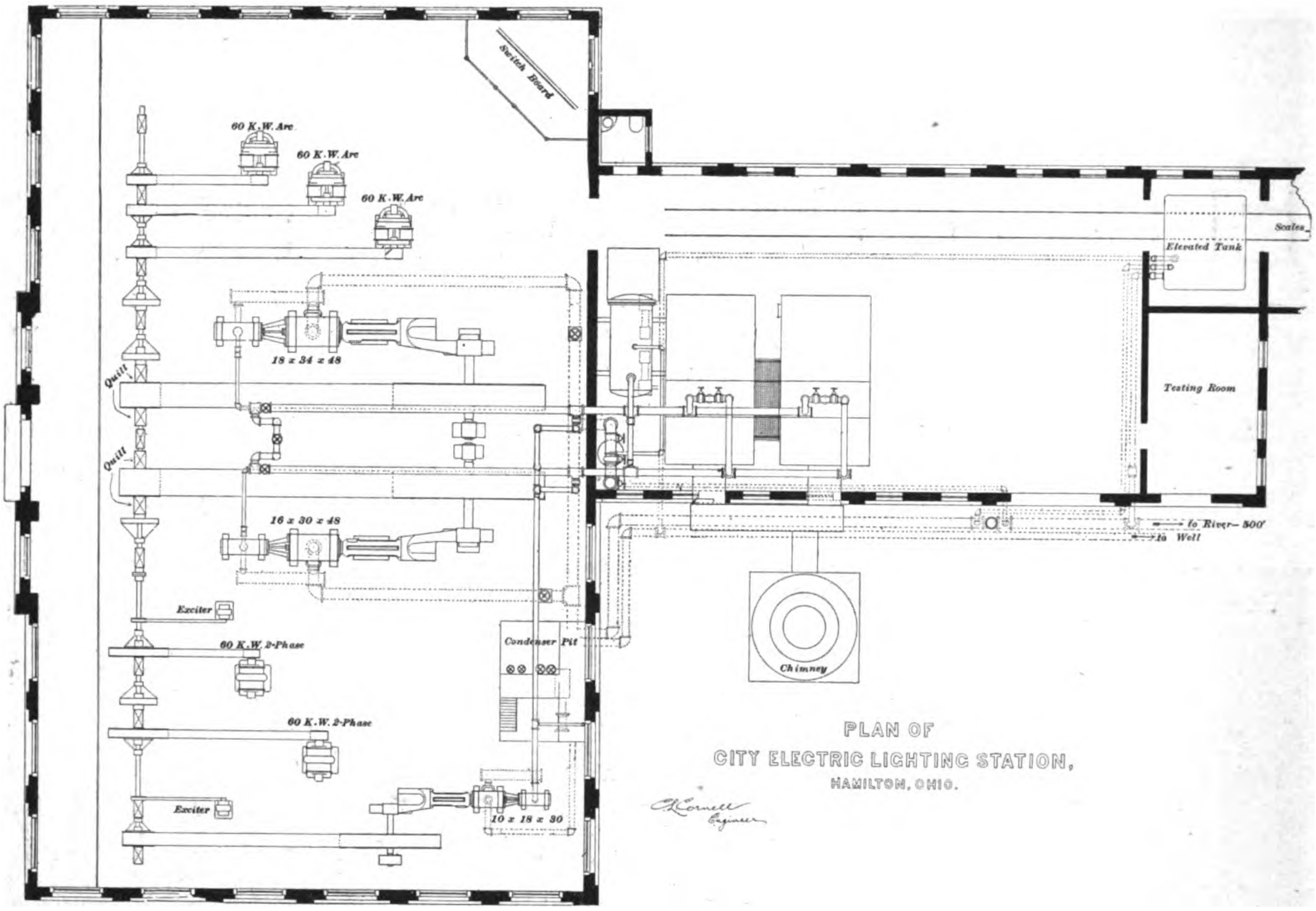


FIG. 3.—THE LIGHTING OF THE CITY OF HAMILTON, OHIO.—PLAN OF STATION.

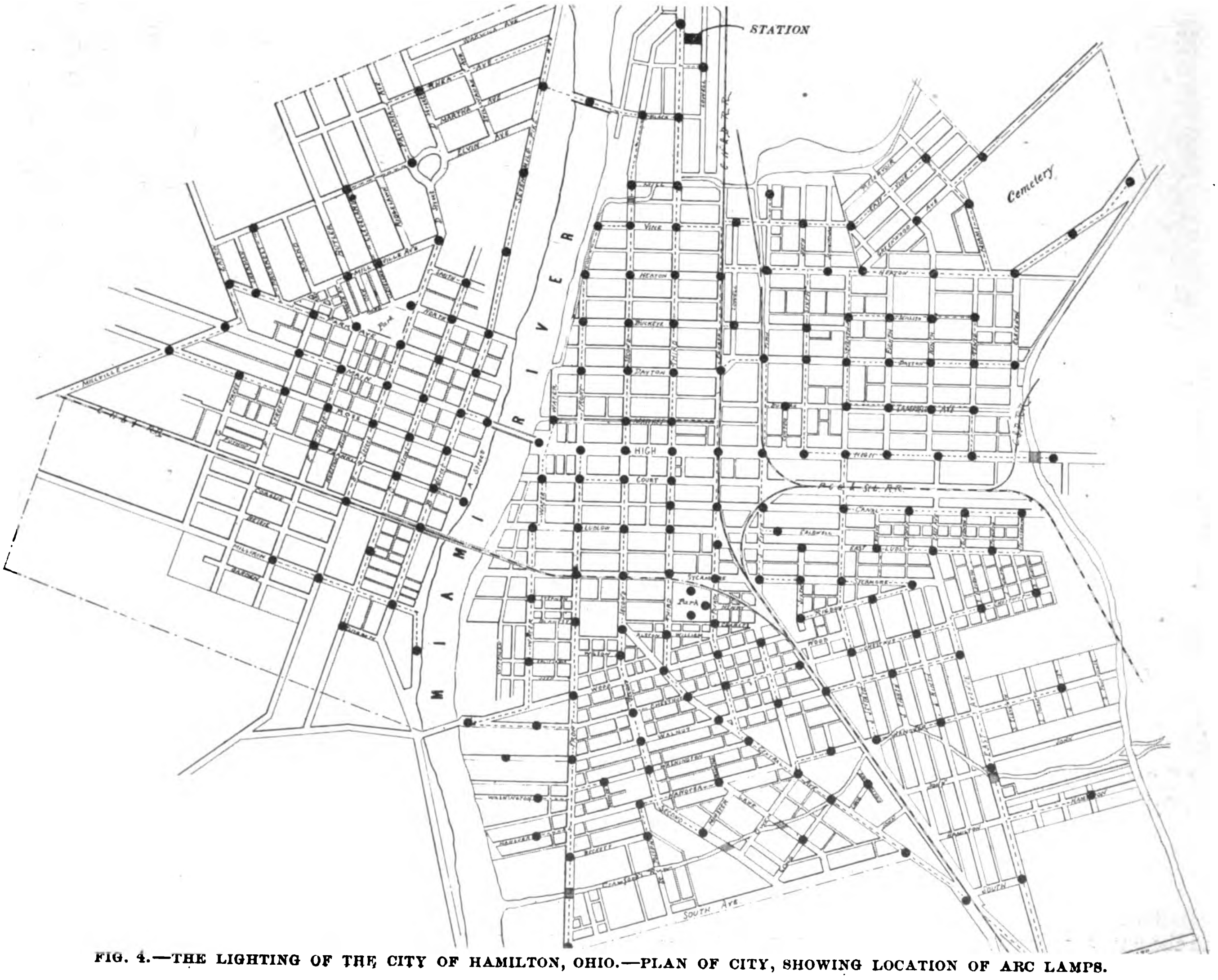


FIG. 4.—THE LIGHTING OF THE CITY OF HAMILTON, OHIO.—PLAN OF CITY, SHOWING LOCATION OF ARC LAMPS.

two parts—first arc dynamos and circuits for street lighting alone; second—alternating apparatus, necessarily polyphase, to be run continuously, with circuits for distributing electricity for all purposes except street lighting. In order to keep within the appropriation, it was necessary to confine the alternating distribution at the outset to the principal business portion of the city.

Although bids for the equipment of the plant were received in July 1894, work was not begun until December. The severe winter and other causes delayed the completion until September of the present year. Although the plant has been in operation only about three months, there is every indication that with ordinarily good management, the investment will prove a wise one for the city.

About 1,300 incandescent lamps have already been connected with the mains, and applications are coming in quite as rapidly as the work of making connections can be done by the employes. Electricity is supplied only by meter—the necessary meters being furnished by the city without charge—and the rate of charge for electricity has been fixed at 12 cents per 1,000 watt-hours. The rate of charge for power purposes has not yet been finally fixed.

The pressure in the primary mains is 2,000 volts, and this is reduced to 100 by transformers feeding into secondary mains. There are usually two similar transformers connected to each secondary main. The station is situated at the North end of the city, about 500 feet from Old river, and 23 feet above the mean level of the stream. A brick building, which was on the property when purchased by the city, was used for a boiler room. The other part of the station is new, as shown in Fig. 1.

Three compound condensing Hamilton Corliss engines furnish the motive power. The smallest engine (10x18x30) carries the day load. The other engines are 16 by 30 by 48 and 18 by 30 by 48 respectively. One of these carries the night load while the other stands idle as a reserve. Of course any combination of the three engines can be used as required.

The exhaust is carried to a condenser pit where two Gordon condensers are connected with the exhaust trunk. The condensers can be used separately or together as required. The water for condensing is brought indirectly from Old river, some 600 feet. To avoid the disadvantages of great length of suction pipe, and to secure the advantage of clearer water, a receiving well was built in low ground lying back of the station. Water flows from Old river through an 18-inch sewer pipe into this well, and the condensers take their supply from the well. The condensers discharge the overflow into Old river through a 12-inch pipe, but, when necessary the overflow can be carried to a tank in the rear of boiler room, by throttling the discharge. The boiler feed pumps take their supply either from this tank or from the suction pipe of the condensers.

The arrangement of the station is shown in the floor plan of the station, Fig. 3. The engines are belted to the line shaft from which the individual machines are belted on friction clutch pulleys. This line shaft is divided into sections by cut-off couplings so as to secure most economical results, and the main driving pulleys are carried on quills to relieve the shaft of the belt tension.

Two Root boilers, of 210 horse-powers each, supply steam for the plant. The feed water is pumped through a heater where it is warmed by the exhaust steam from pumps and condensers, thence to a Hoppes live steam purifier from which it passes by gravity to the boilers. The water of the Miami Valley is noted for its scale-forming properties, but there is no indication of scale in the boilers at the present time, although no boiler compound of any kind has been used. Great quantities of deposit are, however, removed from the purifier at regular intervals. The draught of furnaces of boilers is controlled by Locke damper regulator.

It was intended to use a self-sustained steel chimney for the station, but local influences overruled this decision, and instead of this a brick chimney was put up. The chimney is 125 feet high and has a clear opening of 5 feet. The plant is designed throughout so as to insure reliability of service. The steam piping between boilers and engines is in duplicate, and a boiler, engine, arc dynamo and alternator is always in reserve. It is the intention of the city to add additional apparatus from time to time as may be necessary to carry out this design.

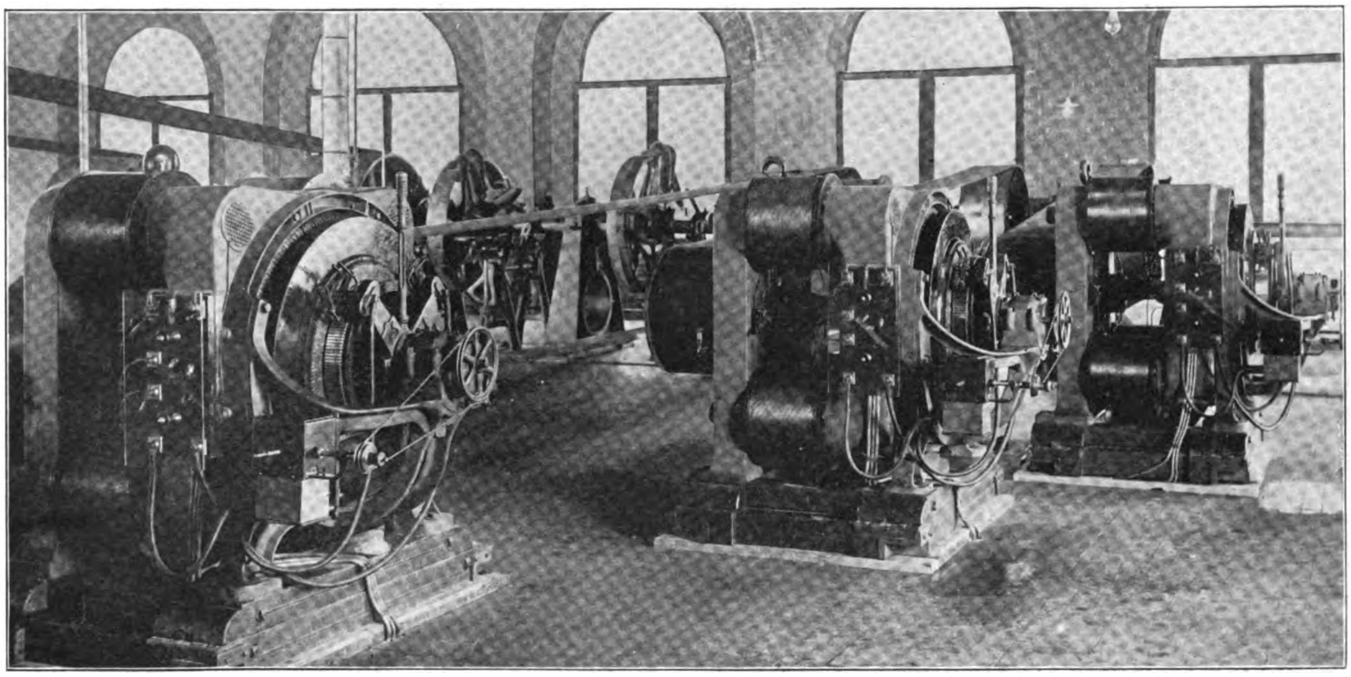


FIG. 5.—THE LIGHTING OF THE CITY OF HAMILTON, OHIO.

The electrical equipment of the station consists of three 60 kilowatt (at 500 revs.) Western Electric arc dynamos, two 60 kilowatt Stanley two phase alternators, and two 3 kilowatt exciters. The switchboard is supplied with the most modern appliances for indicating, measuring and testing purposes. Arrangements are made for running the alternators in parallel in their regular work.

The arc lighting equipment and the incandescent switchboard were furnished by the Western Electric Co. of Chicago. There are three of its 100 light high-tension arc machines installed at present, and two more machines will be added later as occasion may require. The large jack shaft extending along one side of the room carries the clutch pulleys from which these dynamos are independently driven, each dynamo having its own clutch pulley so that it can be thrown in or out of service at any time without interfering with the operation of the other machines. The dynamos are slow speed being run at 500 revolutions per minute and are each furnished with automatic regulators capable of governing from no load to full load without manual adjustment. The bearings on these machines are large and self-aligning, self-centering, and self-oiling, enough oil being contained in the chambers of the bearings to last for weeks without replenishing. Large rings carry the oil upon the shaft and keep the bearings perfectly lubricated while leakage along the shaft is prevented by grooves and shoulders combined with properly arranged receptacles.

The bases upon which these machines are placed are of sliding type, and by means of a tension screw the belt tension is made anything that may be desired. The material of which the bases are made being thoroughly seasoned hard wood, the machines are thoroughly insulated from the foundation and trouble likely to come from grounds on the lines are reduced to a minimum. As will be seen in the cut, the connection from dynamos to switchboard are all carried below the floor and are heavily insulated wire protected by lead covering.

The switchboard is of white marble set in an ornamental casing of polished hardwood. It is placed diagonally across one corner of the room, and, as before stated, carries the arc and incandescent instruments and circuit terminals. The portion of the board devoted to the arc machines carries terminals for five dynamos and five circuits, three Western Electric polarity indicators, three Western Electric ammeters, one direct reading Weston voltmeter, reading to 6,000 volts, and an improved Rudd ground detector. This ground detector is a most valuable adjunct to a switchboard, for it enables the operator to locate and measure the resistance of a ground upon the circuit which is supplying a load of lamps; and when a ground occurs, the fact is immediately announced by the fall of a small annunciator drop that at the same time rings a bell to call the operator's attention to it. Briefly, the apparatus consists of a circuit of high resistance, so arranged that it parallels the lamp circuit; and when a point has been found on this resistance—that is, at the same potential as the ground—then it is only a matter of proportion to determine the position of the ground on the line. After the point on the high resistance has been found, that is at the same potential as the point on the line that is grounded, then we evidently have a point on the high resistance at which we may attach a Wheatstone bridge and measure the resistance of the ground. Included with it, however, will be that of a known portion of the high resistance parallel circuit, which resistance may afterwards be subtracted, and the remainder will be the resistance of the ground. By an ingenious arrangement of condensers with annunciator drops and bell, a ground is made known as soon as it occurs, and the circuit upon which it is to be found is also shown.

The lamps are of the encased single carbon type, and will burn for 16 hours with a single trimming. These lamps are suspended from weatherproof bell-hangers, and the connections are made from hanger to lamp by means of a cord and plug. In case it should be desired to remove a lamp from the circuit while in operation, it is only necessary to shift the switch handle on the under side of hanger, when lamp may be handled with impunity, since the hanger contains a double-pole switch which cuts out and entirely insulates the lamp and its conductors.

The park lights are hung from special park posts, designed especially for this contract, and are of neat and tasty appearance; the wires are strung from insulators attached to the posts at the top of the straight portion and from insulators, are carried up to the weatherproof hanger to which, as before explained, the lamps are connected by means of cord and plugs.

The alternating current machinery and system of distribution form an important part of this lighting plant. The system is that of the Stanley Electric Manufacturing Company, of Pittsfield, Mass. The generators are of a novel design which, involving no moving wire, no collector and no commutator impresses one with its great simplicity and strength. These alternators run at low speed and yet are comparatively small in size. In this type of electrical generator which has been developed exclusively by the above company, the fields revolve, or, rather, what corresponds to the fields of the old types of machines. These fields are made of a steel casting upon the periphery of which polar projections of iron laminae are securely fastened. There are no wires or conductors on this inductor, as it might be called.

The armature is also of a special design. The individual coils are small and are placed in the laminated supporting frame of the dynamo in such a way as to envelop the revolving fields. This frame of laminated iron answers the same purpose as the armature core. These coils can be easily removed from the grooves in which they rest. The central station manager always fears the burning out of an armature, but with this machine it loses its terror since the renewal of a coil is a simple matter. A few extra coils kept in stock are all that is necessary.

These machines, one of which is shown in the foreground of Fig. 2, are provided with large self-oiling bearings, a broad, substantial base. From the alternating circuits which cover the business districts of the city both lights and motors are run. They have the double advantage of being able to supply both light and power at considerable distance from the station with a very small loss in transmission.

In Fig. 4 is shown a map of the city with the location of the arc lights marked. Fig. 5 shows the arc plant. The entire installation was planned and completed under the direction and supervision of Mr. Charles L. Cornell, a well-known electrical engineer of Hamilton. Much of the credit for the excellence of the plant and the promised success of the undertaking is due to Mr. Cornell, who has also supervision of the plant.

The National Electrical Exposition.

An electrical exposition is being planned for the month of May, 1896. It is to be held under the auspices of the National Electric Light Association and approved by the American Street Railway Association. A generous support has been promised and arrangements are being perfected for such a list of electrical apparatus and inventions as will show both the progress of the industry and its present advancement. The National Electric Light Association holds its annual convention in New York on the 5, 6 and 7th of May, and this exposition is to open with the opening of the convention. The meetings are to be held in the same building, the New York Industrial building, Forty-third St. and Lexington Ave.

To conduct the business end of this exposition a stock company has been formed, called the National Electrical Exposition Co. The stock has all been subscribed and the first installment of ten per cent. paid in. The officers of company are, president, Harrison J. Smith, of the Edison Illg. Co., New York; vice-president, Wm. J. Weiss, of the New York Steam Co., and secretary and treasurer, Geo. F. Porter. The executive committee consists of H. J. Smith, C. O. Baker, jr., R. B. Corey, H. L. Lufkin and E. F. Peck.

The building in which the exposition is to be held, was constructed expressly for exposition purposes and it has contained many important industrial exhibitions. It is seven stories with roof garden; has a lighting plant of 5,000 incandescent lamps and a spare steam plant of 300 horse-power. There can also be obtained any amount of light and power from the illuminating companies of the city. The building will afford excellent accommodations both for the meetings of the convention and the exhibitions. It is contemplated to make this the greatest electrical exposition ever held.

The office of the company is at 126 Liberty St., New York, where all communications should be sent. The company is prepared to receive applications for space at any time. The exposition is to be open May 4th and continue during the month.

In accordance with the wish of the members the convention is held later in the season this year. The change will be undoubtedly conducive to a larger attendance and greater comfort at the convention.

The Photometry of Arc and Incandescent Lamps.—III.

BY PROF. W. M. STINE.

Description of a Simple Photometer.—The two preceding papers have set forth in a general way the elementary theory of photometric measurements, while the present number will deal with their application in the practice of such determinations. Many and various methods have been designed to accomplish this, but the law of the survival of the simplest and most efficient has caused the method of the German physicist, Bunsen, to be almost universally employed outside the laboratories. The Bunsen photometer is thus presented to the consideration of those having to do with central station work, as the simplest and at the same time one of the most reliable pieces of apparatus for the measurement of candle power. Many refinements have from time to time been introduced, which have more or less influenced the sensitiveness of the apparatus, but as these are required rather for research work than practical measurements, they will not be described, for they would only needlessly confuse the subject. Many practical electricians are debarred from much instruction and profitable scientific work by searching for information in works written only for exhaustive discussion of all the various minute and intricate details of their subject matter. They look in vain for a simple and comprehensive statement of the elementary principles of the subject in hand, and finding only tedious formulas and obscure discussions, turn away disheartened, thinking the whole subject too far beyond them. This broadly illustrates the difference between the rigorous research work of the laboratory and approximate methods which are sufficient for commercial work. In practice, resistance rarely need be determined within an error of one per cent, while in the laboratory an accuracy 100 times as great is often necessary. These reasons have prompted the writer to select the simplest possible photometer to illustrate the present paper. However, data will be presented, which will prove it entirely adequate for the purpose in hand.

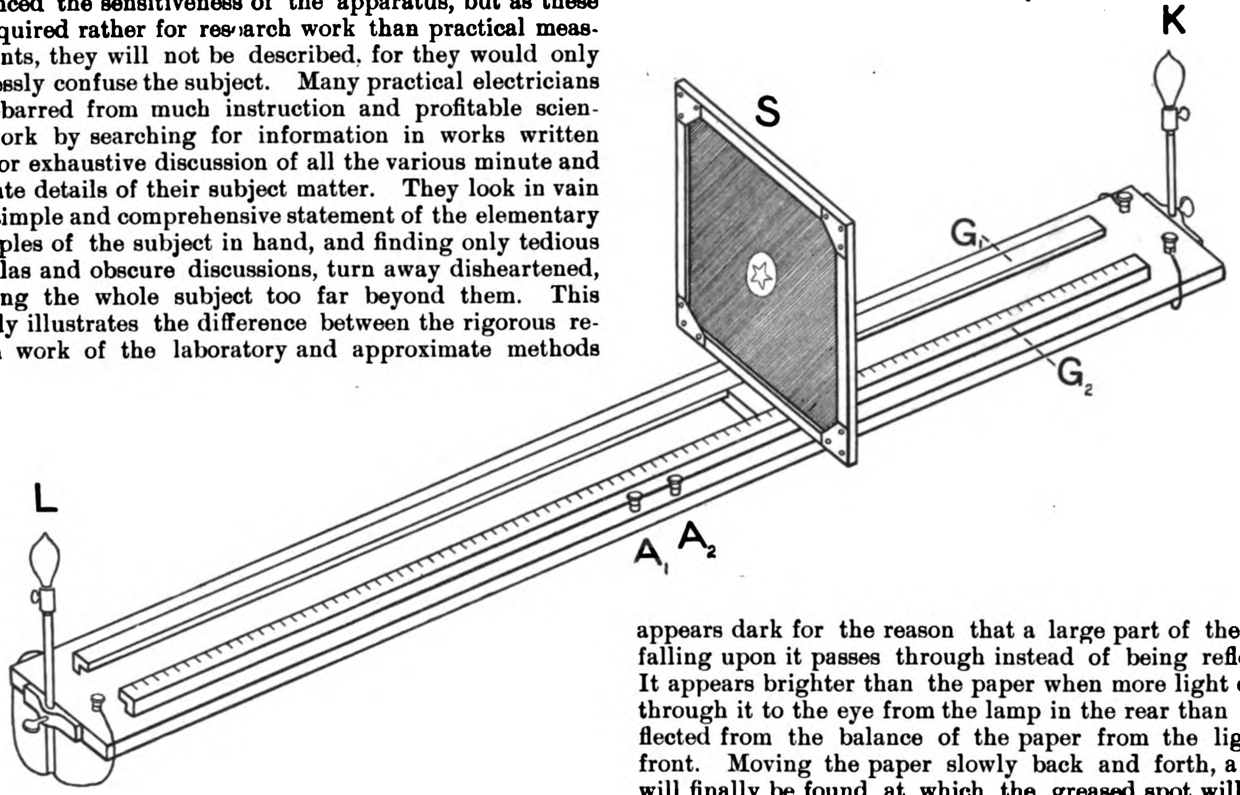


FIG. 1.—THE PHOTOMETRY OF ARC AND INCANDESCENT LAMPS.

A simple Bunsen photometer is shown in Fig. 1. It consists of a base board, 250 centimeters, or 100 inches, in length, measured between the centers of the rods supporting the standard L_1 and the lamp K. On the board are fastened two ways, or guides G_1 and G_2, between which slides a block, carrying the reference screen S. The screen is a stout wooden frame, covered with a stiff sheet of cardboard. A circular hole of about 4 inches diameter is cut out of the center of the cardboard. The screen proper is made by covering this opening with a piece of white paper with a dull surface. In the center of this paper a figure, such as a circle or star, is worked out with a little oil or paraffine. Finally all the wood work and metallic parts of the photometer are painted a dull black. The entire screen, too, is painted black, with the exception of the small circular opening covered with the white paper and transparent spot. On the bottom of the board two wires run, lengthwise, connecting the binding posts shown at its ends. These wires are connected to the binding posts A_1 and A_2 respectively. Two incandescent lamps can thus be compared. Connection is made at A_1 and A_2 with the lighting mains, and the ends of the lamp cord wired to the sockets at L and K are fastened to the end binding posts.

The Use of a Simple Photometer.—The essential member of any photometer is the screen, all the other parts being merely auxiliary. The function of the screen is best illustrated by a very simple experiment. Take a sheet of white writing-paper, preferably linen, with a dull finish, and grease a spot at the center to make it transparent. Hold the paper in a line between two oil or incandescent lamps separated a distance of about ten feet. Look at the greased spot closely, and move the paper slowly back and forth. In one position the greased spot will appear dark on a white surface and grow darker the further it is moved in this direction. Moved in the opposite way it will grow brighter than the surface of the paper. The explanation is as simple as the phenomenon. The greased spot is transparent and readily allows the light to pass through, while the rest of the paper is rather opaque and reflects the light. The spot appears dark for the reason that a large part of the light falling upon it passes through instead of being reflected. It appears brighter than the paper when more light comes through it to the eye from the lamp in the rear than is reflected from the balance of the paper from the light in front. Moving the paper slowly back and forth, a point will finally be found at which the greased spot will suddenly almost disappear, and the paper seem to be uniformly lighted. In this position an equal amount of light is passing through the screen in both directions, or, what amounts to the same thing, the spot is balanced and the paper is equally illuminated on both sides.

We will suppose a standard candle has been placed at L (see Fig. 6 of the second paper) and an incandescent lamp at K. Looking closely at one side of the screen, move this back and forth until the spot and the paper are found to be equally illuminated. The greased spot will always be slightly visible, since owing to its greased surface, its power of reflecting light is less than than of the white paper surrounding it. When this balanced condition has been reached it must be proved, that is, the screen should be moved slightly to the right, when the spot will begin to grow dark, then it is to be moved to the left until it grows slightly lighter than the paper. Now moving the screen back slowly to the right until the spot disappears, it is allowed to remain here and the lights may be considered to be balanced. This double movement will relieve the eye by the contrast between the slightly darker and brighter spot, and enables the exact point when the spot be comes balanced to be more accurately judged. It also serves another purpose: It shows just how much the screen may be moved without changing its balance materially. This expressed as a ratio denotes the accuracy of the observer, or the percentage of possible error in his readings. As an example, two incandescent lamps of about equal candle power were placed at L and R respectively on the photometer here described. When the balance was obtained it was found that the distance from L to the screen S was 125 centimeters.

It was further noticed that a perceptible change occurred in the appearance of the spot, if the screen was moved one centimeter either way. The error in setting the screen was then one part in 125 or 8-10 of one per cent. It is urged that a beginner in photometry frequently makes such calculations, for they serve as an excellent indication of the expertness of the observer.

Returning to the condition above, after balancing the screen, the next step is the measurement of the distance of the lights from the screen. Such distances must be measured as accurately as possible and expressed in inches or centimeters. In every case these distances must be measured from the centers of the lights to the paper of the screen, both lights and greased spot being placed on the same straight line. A general formula for calculating the candle power of K in terms of L will prove convenient. To derive this let the distance from the screen to L be designated by a and from the screen to K by b, then

$$K = L\frac{a^2}{b^2}$$

The value of the standard L being known, and the distance a and b measured in inches or centimetrus, the solution of this equation will give the candle power of the lamp K.

So far in this discussion, it has been assumed that an incandescent lamp has been balanced against a standard candle, but this has been assumed only by way of explanation, and most not be taken to indicate that the use of the standard candle is to be recommended. The standard candle here referred to is what is known as the spermaceti or English candle, and weighs ⅙ pound each, and should burn at the rate of 120 grains per hour. All candle-power designations in America and England refer to such a candle as the unit. German lamps are sometimes sold in this country, but they are marked in terms of another unit. This is the paraffine candle or German "Kerze," and its light is brighter than the sperm candle, one German candle being equal to 1.13 English candles. In the trade no distinction seems to be observed, for some supply houses sell this paraffin candle for the standard candle, and unless the user bears this in mind, his readings may prove too low; a 16 candle-power lamp is thus only 14.1 German candles.

In the first paper it was pointed out that the amount of light emitted by a candle varies with the height of the flame. A standard sperm candle gives unit light when its flame is just 1¾ inches high and burning in quiet air. In short, none but the most experienced worker can obtain reliable results with a candle, and even then such pains and precautions are necessary as to preclude its use outside the laboratory.

For these reasons it is strongly advised that a standardized incandescent lamp be used instead of a standard candle. Extensive tests have shown that an incandescent lamp, after burning for 75 or 100 hours, remains constant in candle-power for the succeeding 100 or 200 hours. If such an "aged" lamp be carefully measured, it can be relied upon as a standard for a great number of tests, provided proper care is taken of it. Although such lamps are not now offered by the trade, they can readily be obtained from reliable laboratories or from some of the lamp companies.

Most central stations are now supplied with portable Weston voltmeters for testing purposes. These, when well cared for, are sufficiently accurate for the purpose to be indicated. Fig. 2 shows the plan of the wiring of the photometer and all connections for the use of a standardized incandescent lamp. Suppose both lamps are to be rated at exactly 110 volts. The voltmeter is connected to the posts A^1 and A^2, and an adjustable rheostat R is inserted in the circuit so that the voltage of the mains may be adjusted to that required by the lamps. The screen should be balanced at the exact voltage required, and if the candle power of the standard lamp be substituted for L in the equation given above, the candle power of the compared lamp K is readily found. To properly care for such a standard lamp several precautions must be observed. It should not be left burning except when taking the readings; it must not be burned, even for a short time, at a higher voltage than that at which it was rated; it should always be used in the marked position indicated in its certificate.

It is well to begin photometric practice by using any convenient incandescent lamp as a standard, and then when sufficient skill has been attained, a regular standard may be employed. It is also advisable when a standard lamp is received, to calibrate several "aged" lamps for immediate use, reserving the standard to check these at intervals. It must also be borne in mind that the position of the filament must be attended to, as pointed out in the second paper.

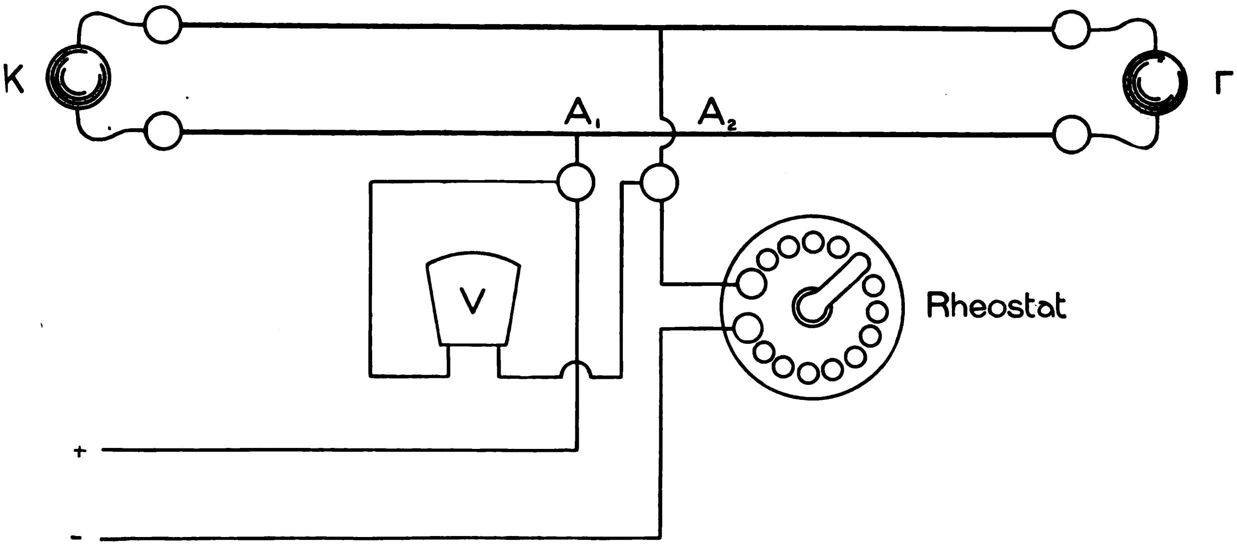


FIG. 2.—THE PHOTOMETRY OF ARC AND INCANDESCENT LAMPS.

A Fly-Wheel Accident at Albany.

A fly-wheel in the power house of the Albany Railway Co. burst on November 12th, doing a considerable damage to the power house, but fortunately doing no injury to persons therein. A dwelling house, two blocks away, was struck by a flying piece of the wheel, eight feet long and four feet wide, and badly wrecked. Flying pieces of the wheel struck a saloon opposite the power house, and four persons in the saloon at the time were injured, one of them fatally. The road was shut down only for a short time and cars were running later in the afternoon. The damage to power house and equipment is estimated at $30,000. A section of the power house wall, 25 feet wide, was demolished.

The Auburn, N. Y., City Railway Co., will issue $300,000 six per cent bonds payable August 1, 1925. The consent of a sufficient number of stockholders has been secured to enable the directors to make the issue. The money will be used in taking up some outstanding bonds and in improving the lines and equipment.

Some Features of the Atlanta Exposition.—I.

The exposition at Atlanta which is now nearing its close, has been a most important opportunity for that large and rich section of this country of which Atlanta is the center. It is affording also to northern manufacturers the opportunity of an acquaintance with the southern markets and the southern people which, so far as it is being utilized, will be of lasting benefit. The roads between this part of the country and other centers of trade are being opened up and the transportation facilities improved. Atlanta is then brought nearer to the cities of the north and its manufacturers. The exposition contains many interesting exhibits and many attractive novelties; which well repay a visit even though that were all that might be seen on the trip. The success of the exposition is remarkable, following as it does the World's Fair and the California Mid-Winter Exposition.

As at the latter expositions electricity has been used extensively for light and power and to enliven and render attractive the grounds and buildings at night. Among the novelties of this character is the floating column, as it is called, shown in the photo engraving Fig. 2. This is a column and platform floated in the center of Clara Meer. The column is thickly studded with incandescent lamps controlled in such a manner that a variety of designs shine out on this column. It is about thirty feet high and has attracted much attention. The lamps are six candle power and are fed by a submerged cable. The tower was designed by Mr. Luther Stieringer, the consulting engineer of the exposition, who designed also the electric fountains and other prominent features of the exposition.

While novelties like the above form interesting and amusing features of the exposition, exhibits of both an interesting and instructive character are found at the plants by which the electricity for lighting and power is furnished. The ideas of the engineers and managers to make the power plant a working exhibit has been fully carried out and this part of the exposition forms one of the most attractive exhibits. The power plant was designed and erected under the direction of Mr. Charles F. Foster, the engineer of the exposition.

The power plant occupies three blocks of space. The first is occupied by the engines and dynamos furnishing incandescent lights. The second is taken up by the pumping plant furnishing water to the fountains, etc., on the grounds. The arc light and power plant occupies the third section.

An important part of the first section is the Westinghouse plant consisting of two 120 kilowatt Westinghouse Elec. & Mfg. Co.'s alternators directly connected to engines of the Westinghouse Machine Co. as shown in Fig. 1. Each machine is accompanied by a ten horse-power exciter. These dynamos are connected to a large switch board near the dynamos. They are operated at 300 revolutions per minute and the current has a frequency of 7,200 per minute. The engine and dynamo are connected by a universal insulated flexible coupling. The engines are of the Westinghouse compound type with cylinders 14 by 24 by 18. From these circuits may be run either lights or motors and the principal buildings of the exposition are lighted from their circuits. A Westinghouse junior engine drives by belt a 350 light Westinghouse direct current dynamo.

Another of the larger generators in this block is one furnished by the Fort Wayne Electric Corporation. This is of 160 kilowatts capacity and operates at 240 revolutions per minute, giving 8,640 alterations per minute. It is driven by a tandem compound non-condensing engine with cylinders 14 by 24 by 16 inches built by the Harrisburg Foundry & Machine Co., of Harrisburg, Pa. An exciter and switchboard accompany the combination and from this machine lighting current for the Forestry, Agricultural, Administration and a number of state buildings is obtained. The alternator is of the Wood type extensively known among central stations. In Fig. 5 at the extreme right this alternator is shown.

While these machines are as compactly arranged as possible, there is an abundance of room for the attendants to get about among them. They are enclosed in neat iron fences so that there is no danger of inquisitive visitors interfering with the machines. More space could well have been used but this was not available.

A novel part of this section is that furnished by the J. I. Case T. M. Co. of Racine, Wis. It is, in fact, the first combination of the kind ever shown at an exposition, and consists of a 100 horse-power quadruple cylinder Raymond improved gas engine, driving a 1,000 light Standard Electric alternator, built by the Standard Electric Co. of Chicago. The defect which has until recently been found in all gas or oil engines, and which renders them unsuited to the operation of electrical machinery, has been entirely overcome in this engine, and it has been placed on exhibition without any hesitation by its makers. It is safe to say that, if the conditions found in the operation of electric plants are successfully overcome, any other class of machinery can be satisfactorily operated.

In the single cylinder the impulse or explosion occurs every second revolution; in the double cylinder, every revolution, and in the quadruple cylinder, every stroke or two to each revolution. The impulses occur in all styles of engines as above described, whether running light or under full load, thus assuring steady motion under variation of load.

In construction it is vertical, of good design, simple, compact, entirely self-contained and enclosed in an iron casing. The main frame or base of engine is cast in one place, strongly ribbed, and contains the bearing for main crank shaft, the latter being well balanced at crank, and also provides a reservoir for oil into which the crank dips at every revolution, thus assuring perfect lubrication of crank and all moving parts. The base is furnished with a large

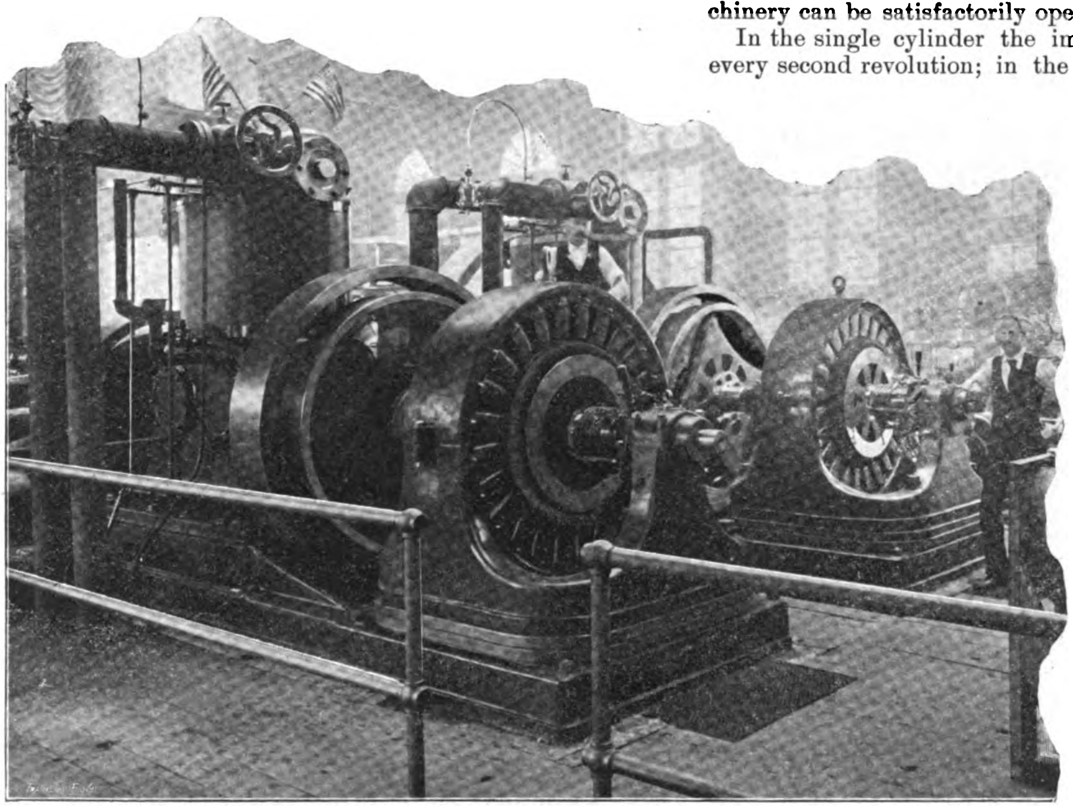


FIG 1.—SOME FEATURES OF THE ATLANTA EXPOSITION.

vent pipe in the back to allow cold air to circulate inside. A special feature with regard to the oiling is the method of oiling the cross head pins in the pistons. This is accomplished with a pump arrangement attached to each connecting rod which forces the oil on these bearings, keeping them cool and perfectly lubricated. The cylinders are bolted securely to base and to the cylinders are bolted the heads which contain the rotary valves and form the explosion chamber. The rotary valves, one of the principal advantages offered, being at the top of the cylinder, are held to their seats by spiral springs. They are supplied with ball bearings and are operated by a set of spur gears direct from crank shaft. Thus it will be seen that the very action of the valves, when working, has a tendency to keep them perfectly seated. They run with very little friction and noiseless.

The governing dovice is of the automatic shaft governor principal and is supplied with ball bearings, to assure ease and freedom of movement. The steadiness with which the engine runs is due to the sensitiveness of this governing device which regulates the exact amount of gas mixture used for each impulse. So sensitive and accurate does this governing device work that scarcely two per cent. difference in the speed of engine can be discerned in throwing on or off a full load of electric lights, or any part thereof, the governor and valves regulating instantly the amount of gas mixture necessary to keep a uniform speed and perfectly steady light.

The ignition of the engines is accomplished entirely by electric igniters, supplied from storage or primary batteries. The electrodes are so placed in the cylinders that their positive working can be seen from the outside; they can also be adjusted from outside while engine is running. Another advantage offered by these engines is that when connected to both gas and oil they can be changed instantly from one to the other with no perceptible variation in the speed. With the patent starter, electric igniters, automatic shaft governor and a perfect oiling system, it only being necessary to keep oil in base and the filling of oil cup for valve, the engine needs very little attention and requires no skilled mechanic.

It is belted to a 60 kilowatt dynamo which is of a new type recently placed on the market. Of the external armature type in which the magnet circuit is largely laminated iron, the size of the machine is very small in proportion to its output. The weight has been greatly reduced but not at the expense of efficiency or durability. It is by the use of most efficient material that these results are obtained. The current from this machine supplies the incandescent lights in the Midway.

Many interesting electrical exhibits are to be found among the exhibits and often where least expected. Visitors notice a printing press in operation, seemingly without any source of power, having no belt connections; but on closer examination, it is discovered that the press has no pulley, but instead, and taking up no more room than the tight and loose pulleys, the Card Electric Motor & Dynamo Company, of Cincinnati, has constructed a multipolar slow-speed motor, which in appearance becomes part of the press. This motor having no gears, is noiseless, and, being directly attached to the main driving shaft, runs at a slow speed. This press is a No. 1 Miehle, with a shaft speed of 165 to 300 revolutions per minute. These motors are not only more efficient than shafting and belting, but give a more regular motion to the press. They are operated through a controller and have five different speeds in a forward direction and one slow back-up speed. The press starts up slowly and evenly and without the jerk occasioned by a high-speed motor or belting and can be stopped by merely pressing a button. These buttons can be placed at any part of the press desired. The motor will go on any make of press and they save a great deal in the cost of power in the press room. The Card Electric Motor & Dynamo Company have motors running on printing presses in Cincinnati, Milwaukee, Des Moines, Boston and New York and also Atlanta; but to many visitors this is an interesting novelty as the source of power that drives this press is almost entirely concealed.

This company has made a specialty of the direct application of electric power to the operation of machine tools, lathes, drill presses, pumps and hoisting machinery. Attaching the motor directly to the tool as is shown in the accompanying engraving, Fig. 4, where the motor is placed in the headstock of a lathe, taking no more room than the cone pulley is an arrangement of great simplicity. Other exhibits at the exposition will be illustrated and described in the next number.

Patterson's Big Chimney.

The chimney of the new Edison Electric Illg. Co.'s station at Patterson, N. J., is the second largest in the state and a most conspicuous object. The chimney at the Clark mills in Newark exceeds this in height. It is 230 feet high, 21 feet in diameter at the base and 13 feet near the top. It is built double with an outside wall six feet in diameter at the base and tapering to about one foot at top. The inside wall runs up 130 feet and is strengthened by heavy iron bands. Between the two walls there is two feet of space which protects the outside wall from the excessive heat of the gases.

Upon the top of the brick work rests a great iron cap weighing 6,000 pounds. On three sides of the chimney are large iron letters, E, weighing about 400 pounds each, although they look from the ground as if they might be carried under the arm. The chimney was built in exactly six weeks, which is a remarkably short time for such a piece of work. There are nearly 1,000,000 bricks in this chimney.

This chimney is not alone remarkable for its height and the rapidity of its construction but also for the use of electric power in raising the great quantity of material. An electric motor of seven and one half horse-power operated the hoists used in the chimney. Two platforms as are commonly employed were used on this hoist. One platform descends as the other ascends, both running within the chimney. Very rapid work was done in raising the brick and mortar by this means.

Since the platforms are concealed within the walls except when at the top or bottom, a set of signals were necessary to insure the safety of passengers and material. An electric bell operated by a push at the top announces that the elevator is ready to descend. Twenty feet from the bottom an automatic bell is placed to announce to the man in charge of the motor the position of the hoist. When the hoist rings this bell the speed is cut down so that it gradually comes to a stop at the bottom. Passengers and material were carried to the top in seventeen seconds.

The heavy letters on the side of the chimney and also the heavy iron cap on the top, which is in four pieces, were raised by this electric hoist. Its work was satisfactory in every respect and met the requirements most successfully. The small area at the top of the chimney did not permit the material being raised except as it was used. An iron adder was built into the side of the chimney by which the top of the chimney can be reached, although few would care to make the ascent. From the top a magnificent view may be obtained of the surrounding country.

Electric Fan Blower.

Merchants through the winter months have great difficulty in keeping the windows of their stores free from the ice and frost which shuts out the light and obscures the displays placed in their show windows. A simple device built by the Emerson Electric Mfg. Co., of St. Louis, is a most effcient remedy. A small fan blower operated by an electric motor is placed in any convenient position near the window, preferably below it. The pipe from this blower leads to a split outlet tubing placed along the bottom of the sash. By this apparatus a constant current of cool air as broad as the window passes over the glass, carrying away any moisture that may collect there and keeping the warm moisture laden air away. The windows are kept as clear as during the warmer seasons of the year.

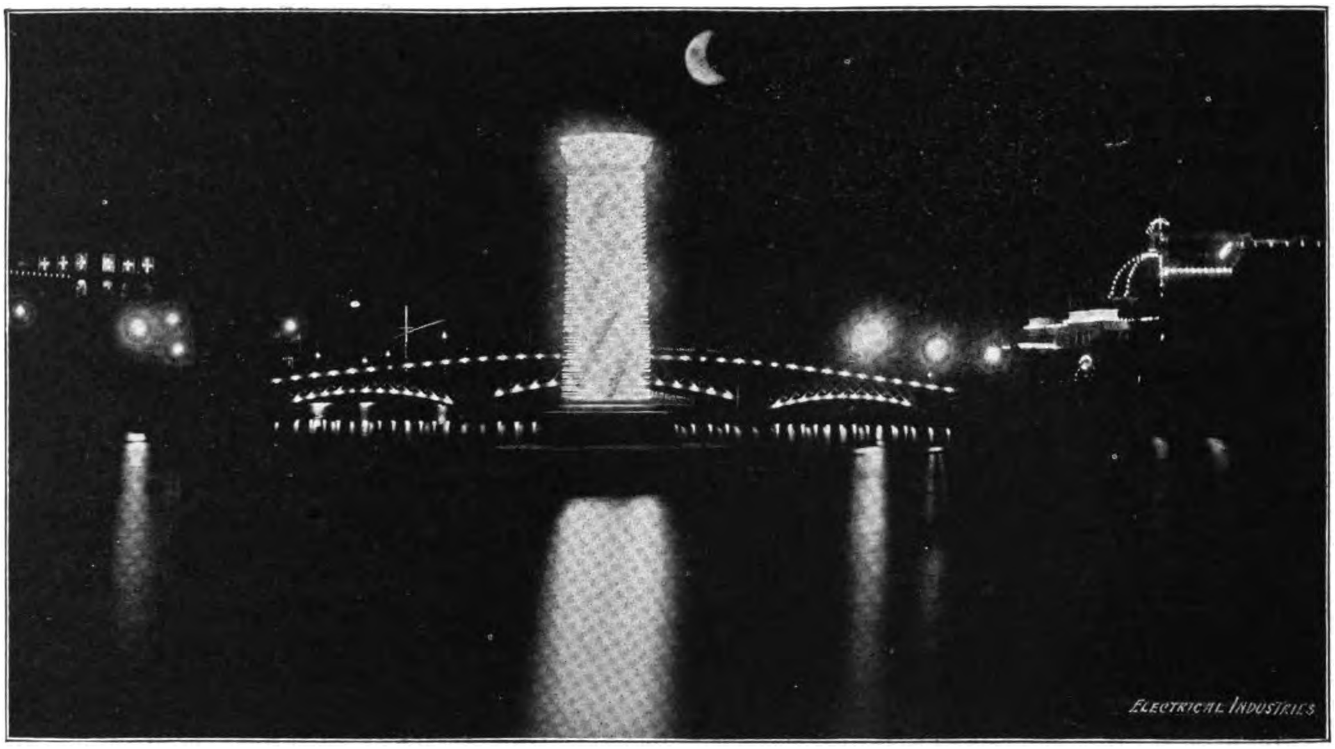


Fig 2.—The floating Column.

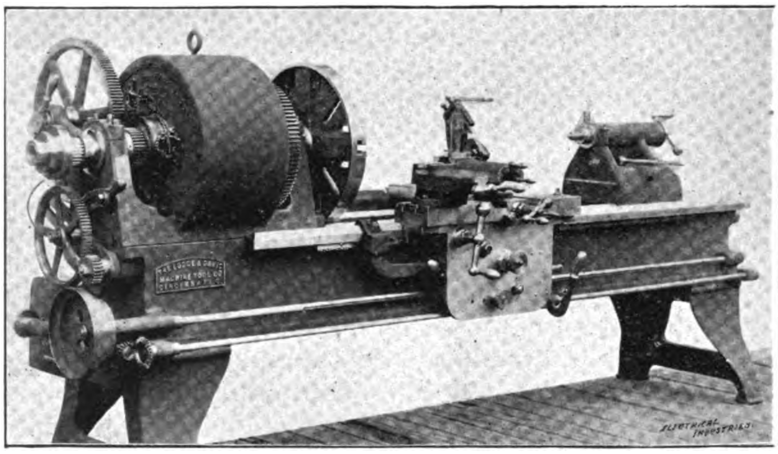


Fig. 3.—Card Motor Driving Lathe.

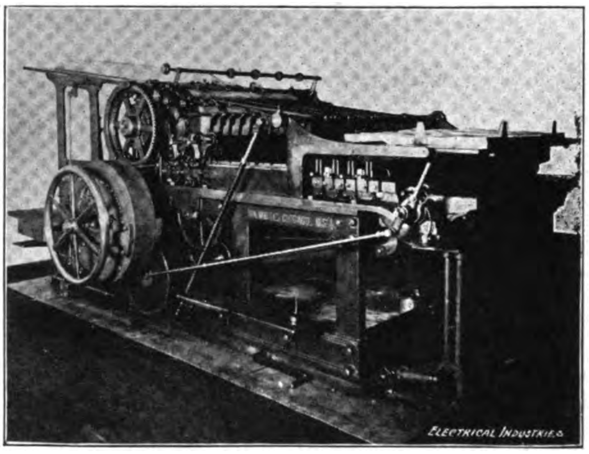


Fig. 4.—Card Motor Driving Press.

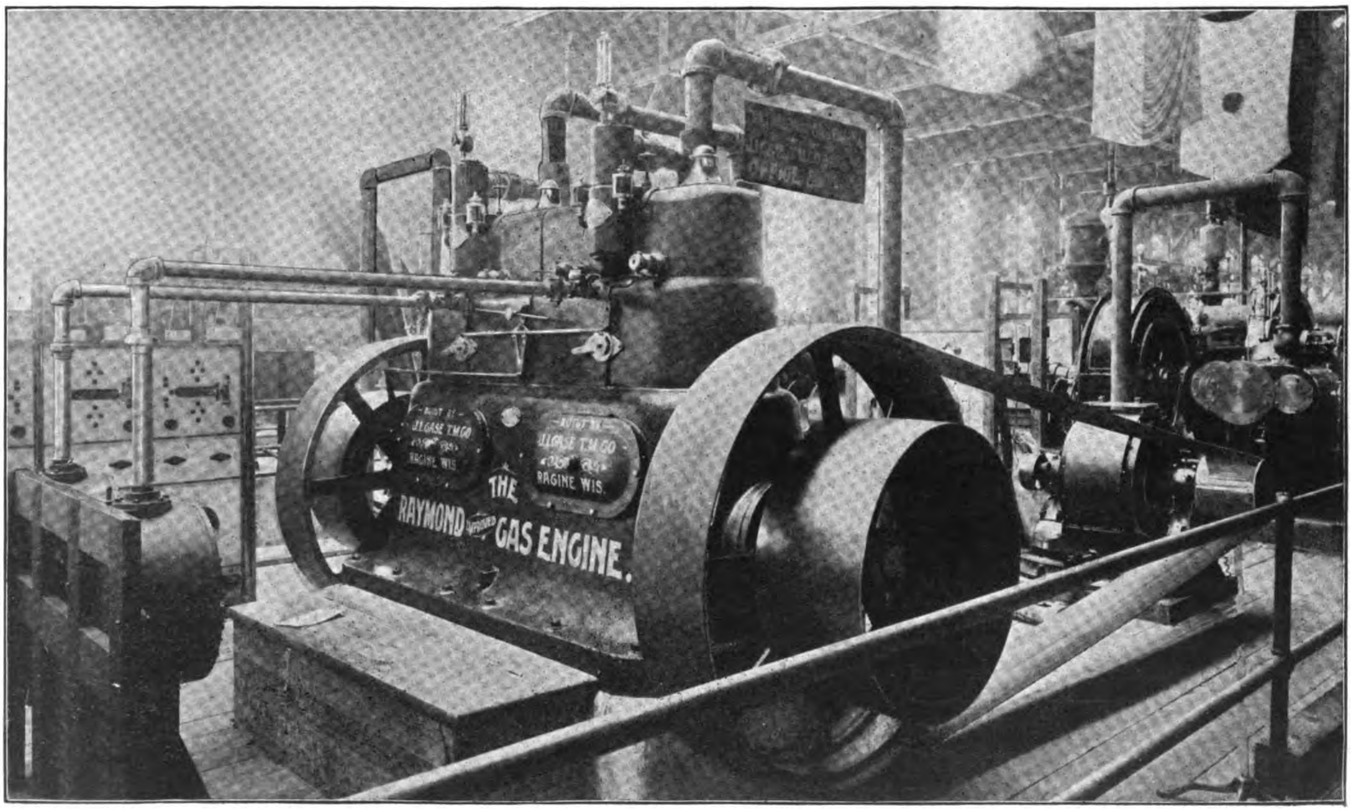


Fig. 5.—Raymond Gas Engine Driving Standard Alternator.

FIGS. 2, 3, 4 AND 5.—SOME FEATURES OF THE ATLANTA EXPOSITION.

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Communications on subjects of interest for insertion in any of the departments of the paper will be accepted for publication at the discretion of the editors. Articles from practical men on subjects relating to the construction, design, care and operation of electrical appliances are especially desired. Information of interest regarding new projects, new inventions or new applications of electricity is also solicited.

To unwrap your paper, pull out the string which you will find in the wrapper.

THE special cover in which this number is bound has been designed, appropriate to the season, to mark the close of Vol. VI. It has become the custom with many of the best periodicals to dress the issue nearest the holidays in a cover suggestive of the season. ELECTRICAL INDUSTRIES, although a class paper devoted to special industries, accustomed to the sterner lines of business, lays aside for this issue its business dress and in holiday attire extends to its many old subscribers, and the thousands who have become subscribers during the year, the compliments of the season, and wishes them, one and all, a merry Christmas and a happy New Year.

THE lines marked out a year ago for Vol. VI. have been followed as closely as possible. The different departments of the paper have received careful attention, the special articles have been prepared to bring out either the latest practice or to show the defects of the installation, and such a record of events has been presented as shows the advancement during the year of the industries represented. The latest inventions, researches and investigations, in so far as they relate to the interests of the industry, have been illustrated and described. The great power plants completed during the year for the generation and transmission of electric power have been fully illustrated. With all matter inserted in the reading pages it has been the aim to separate it entirely from the influence of the advertising department. Nothing has ever been published in the reading columns for pay, and it has been the constant effort of the editors to remove every trace of the trade paper style and to give the readers unbiased information respecting the great industries represented by this journal.

ELECTRICAL INDUSTRIES for 1896 will be better than ever. The generous encouragement accorded it in the past from all sides is ample indication of the importance of the field it occupies almost exclusively. Kind assistance has been freely offered by the best known men connected with the industry, and by their advice, drawn forth by their interest in and love for the work, has the policy of this journal been shaped and its field clearly defined. Its numerous friends, thickly scattered from ocean to ocean and from the isthmus to the outlying regions to the north, will assist in making the coming volume the best that has been issued. Arrangements have already been made with a number of practical men, well posted and experienced writers, who will contribute special articles on the operation and repair of electrical machinery, the proper methods of installation, and electricity as applied to machinery in general. The electric railway, its equipment, operation and repair; underground construction, electricity in the machine shop, and many other equally important subjects, will be taken up. The illustrations have always been a special feature of this journal. Working drawings often accompany the articles to show as clearly as possible the exact construction, and no pains are spared to give accuracy and clearness to the illustrations. The publishers always aim to keep in their employ the best artists obtainable. The next volume will be illustrated to a greater extent than those in the past, and the quality will be improved in every manner possible.

A RECENT fatality which has received wide publicity through the prominence of the person killed, draws attention to the necessity of good workmanship in every electrical installation. While the report of interested parties who made an investigation of the circumstances of this accident has not been published, the inference drawn from the report of individuals who examined the premises, is that the shock was received from a roughly twisted and poorly insulated joint in a high potential primary circuit. In few industries is there the opportunity for poor work and to do temporary work in connection with permanent installations which electric plants afford. Ordinances passed by city councils, the vigilance of the insurance inspectors and the influence of electrical associations have done much to improve the character of electrical construction. There are, however, far too many plants with systems of distribution a constant menace to life and property, and through the resistance of the circuits a heavy drain on the coal pile of the operator.

Sharp business competition is not alone responsible for this condition. Hasty construction, unreliability or ignorance of the workmen employed, an effort to economize in cost, which results in poor construction, and placing the care of the installation in incompetent hands will be found the cause of a large part of the defective work. The reader will possibly recall many instances of this kind. An installation of nearly four thousand incandescent lights was upon its completion most carefully tested and inspected, both for the purpose of finding out how well the contractor had done his work and of learning the condition of the electrical equipment. Upon the result of these tests the contractor was complimented and the owner congratulated. A few months later the installation was shown to some visitors interested in electrical work, with a result quite different from that expected. The equipment had greatly degenerated; new lights had been put in in a most careless manner; the joints were not soldered and in many places not taped; the lines were tapped where most convenient and the wires passed over iron pipes and around corners with no protection except the insulation of the wire. The visitors, who had been promised a model plant, smiled significantly as they departed. They asked, of what use is the elaborate conduit system, the large asbestos-lined cut-out boxes, with their large fuse blocks, the many protections against fire, the great expense of the equipment, if lights are afterwards to be added and wiring done after the manner of an amateur bell hanger? The man who had been placed in charge of the plant, was of a kind of wiremen of which there are far too many employed, and who, like this man, never hold one job long.

Hasty construction or the belief that some other day will give sufficient time to go over the work and do it in a substantial manner, is the cause of many breakdowns and accidents. "That will do for now," is frequently heard and the workman is obliged to follow the direction of the foreman. The fault is as often with those in authority as with the workman. A converter is put in; it is late and there is much to to be done before the current is turned on; the connections are hastily made with the expectation that tomorrow they can be properly attended to; but as there is always a tomorrow, so the connections are never finished. An accident may happen or the joints may hold until the lines are renewed. The danger, however, is always present. Electrical mechanics and electrical engineers may study to advantage the improvements made in recent years in first-class plumbing. It is not the aim to conceal the work but to make neat and attractive all that is not necessarily concealed. The pipes are neatly arranged, the joints well made and the casing that was formerly built over them affording to rodents hiding places, are not allowed. Instead of concealing the work it is made neat and ornamental. Electric wires run on porcelain insulators in straight lines and where corners are necessary, turned at good angles appear much better and are safer than when covered with a heavy casing. The motor, if kept clean, as all motors should be, is better in a corner of the room or on a shelf at the side, than in a dark hole where it gets covered with an accumulation of dust, forgotten because it is unseen, but liable to start a fire, an unpleasant reminder of its neglected existence. The saying, "there is always room at the top," was never more true than at present. First-class electrical workmen are in demand, but the careless and ignorant will always complain of "hard times."

The contribution to this number of Electrical Industries by Prof. Stine cannot fail to be of interest to central station men. A simple photometer is described such as can be made at small expense and can be used by any intelligent person after a little practice. The instructions given as to the construction and use of the photometer are sufficiently minute to enable anyone to make and use one. Regarding such parts as a central station would not be likely to have directions are given as to where they may be obtained. This subject has never before been presented in so clear and practical a manner. The previous numbers of this series of articles have been well received as numerous letters bear witness and this part will be found of even greater interest to the progressive electric lighting men of the country. Another part follows in the January number, completing the series. All interested in commercial electric lighting should not fail to study the subject as here presented.

Various incidents of the recent storm at Chicago and vicinity have been made the occasion for a fresh attack on the overhead trolley, which has but recently entered the central business district. The blame for the accidents, the break downs in the fire alarm, telephone and telegraph systems and almost for the storm itself was laid at the door of the overhead trolley. A morning paper followed an account of the dangers of high tension currents with a list of 336 names of persons said to have been injured by the trolley. So utterly false and grossly exaggerated were the statements that their untruthfulness would seem to be evident to every one and little effort has been made to contradict them in print. Shocks from the trolley wires, such as one would get from a hanging wire, are not fatal. Death has in a few instances resulted from electricity at 500 volts pressure, not from a shock or the momentary grounding through the body of the line but by a prolonged contact in which the victim was burned by the volume of current. The conditions must be unusually favorable for such a result to follow and such cases are extremely rare. One a year perhaps is reported throughout the world in which are now in operation so many thousand miles of electric railway and power systems. The accidents that occur on electric railways are such as would occur were the motive power of any other kind moving the cars at the same speed.

A visit to the electric railway power stations of Chicago, and to the various parts of the systems for the distribution of power from those stations would convince any one of the permanent and substantial character of their construction. Had all wires withstood the storm as well as those of the electric railways, no trouble would have resulted. The small wires which in some parts of the city have been put up in a temporary manner, suspended from the most convenient points and in such a manner that they are easily dislodged, are the cause of the trouble experienced during the recent storm. These wires fall across the trolley and other wires, and the current finds a way to ground, through perhaps some distant wire or a passing wagon. Wires put up are frequently abandoned and both the wire and its support deteriorate and the weight of the sleet and snow brings them to earth. More rigid laws regarding the erection of overhead wires would lessen the fire danger and the interruption of traffic. In the business district all wires are supposed to be underground, but as one looks from a window of a tall office building numerous wires can be seen. Whom they belong to no one probably knows except their owners.

The operation of the conduit electric railway on the Metropolitan system at New York will be watched this winter with interest by street railway men. As the wet, sloppy weather comes the real test of the system will begin and if it proves satisfactory it will be only a question of time when many cable roads will be changed to electric. Local conditions in many places, will, however, limit the use of the underground trolley as used on this road. On level streets where the drainage is poor such systems cannot be used. A storm such as was recently experienced at Chicago would effectively block such a road, while the overhead trolley lines of the city seem to have been affected but little by the heavy, soft snow. The tests that have been made from time have shown the weakness of the systems so far offered and a northern winter has been the barrier which could not be surmounted. While underground trolley lines are now in operation and have been for several years, it cannot be inferred that all cities can have underground trolleys. The riding public, which includes almost everyone, demands an unfailing system of transportation. Reliability comes first, then speed, for which comfort is usually sacrificed. The overhead trolley has proved itself reliable in all kinds of weather.

The Alternating Current; Its Generation and Distribution.—XI.—Transformers.

BY PROF. GEO. D. SHEPARDSON.

The transformer, sometimes called "converter," is a device for transferring electrical energy from one circuit to another without any direct electrical connection between the two circuits. The word has a wide meaning and is applied to devices for changing the energy of (a) a continuous current to another continuous current, or (b) a continuous current to an alternating, or *vice versa*, or (c) an alternating current to another alternating current.

The first two classes involve the use of moving parts, usually a combination of motor and dynamo. A continuous, but pulsating, current may be obtained from an alternating current by the use of brushes and a commutator revolving at a suitable speed. This method has been developed in Europe by Pollak. An alternating current may be obtained from a continuous by brushes and collecting rings connected with opposite points of the armature of a motor or dynamo. For transforming from one alternating current to another, no brushes, collecting rings, commutators, or other revolving parts are required, but simply a stationary iron core with two or more coils of wire. This paper will consider only the latter kind of transformer.

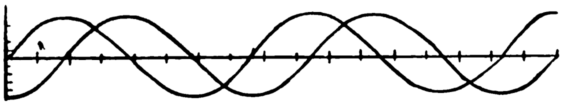

FIG. 28.

With any of these devices the energy in the second circuit is nearly equal to that in the first circuit, a small part being changed into heat energy on account of unavoidable losses in the transformer. It will be evident that while the energy in the second circuit is almost equal to that in the first, neither the current nor the electromotive force need be the same, so long as the true product of amperes and volts in one circuit equals the product of the other. With continuous currents the energy is measured in watts and equals the product of volts by amperes.

With alternating currents the two watts may be the product of volts by amperes or may be less. When the current reaches its maximum value at the same time that the voltage is a maximum, and the two become zero at the same time, the current and E.M.F. are said to be "in the same phase," or simply "in phase," and the energy in the circuit equals the simple product of the amperes and volts. But it usually happens that the circuit has more or less self-induction which retards the current, so that it does not reach its maximum value until after the E.M.F. has begun to diminish. The retardation is usually called the "difference in phase" and is measured in degrees. A straight line drawn from one highest point in the curve to the next highest point or from one zero point to the next corresponding zero, is divided into three hundred and sixty parts or degrees. When the upper or positive maximum of one curve is opposite the negative maximum of the other, the quantities (volts, amperes or watts) represented by the two curves are said to, be one hundred and eighty degrees apart. If one is at a positive maximum when the other is at zero (crossing the center line), as in Fig. 23, the two are said to be in quadrature, or at right angles, or one lags behind the other by ninety degrees. The angle of lag between an E.M.F., and the current it produces may be any valve between zero and ninety degrees. Capacity in the circuit tends to make the current lead the E.M.F. instead of lagging behind it.

When the current and E.M.F. are not in phase, the real energy or watts in the circuit is not the simple product of the amperes by volts, but is this product multiplied by a certain factor known as the "cosine of the angle of lag." This cosine is always less than one (except when the current and E.M.F. are exactly in phase), so that the "true watts" as measured by a wattmeter is a quantity smaller than the "apparent watts" obtained by multiplying the amperes by the volts as measured by ammeter and voltmeter. The difference in phase between the current and E.M.F. introduces complications in the theory and application of alternating currents that are not encountered in the use of continuous currents.

The alternating current transformer is developed from two familiar facts or principles. First, an electric current is surrounded by a field of force. Second, an E.M.F. is induced whenever a conductor crosses a magnetic field, or in other words, whenever the strength of the magnetic field surrounded by the circuit changes. A transformer consists of an iron core surrounded by two coils, one of which (called the "primary coil") carries a current, while the other (called the "secondary coil") has induced in it an E.M.F. which will cause current to flow when its circuit is closed.

An elementary transformer was described in ELECTRICAL INDUSTRIES, July, 1895, page 191. The iron ring X, in Fig. 25, carries two coils. When the switch, Y, is closed, current from battery W pass through the primary coil A and magnetizes the iron ring X. (There are no magnetic poles, since the ring makes a complete and uniform magnetic circuit; but if the ring were cut at the top and bottom, the half rings would attract one another strongly when the coil A carried current.) As the ring becomes magnetized by the current in A, an electromotive force is induced in coil B, since it surrounds the ring. This is indicated by the galvanometer, N, whose needle swings to one side, say to the left. When the current in A has reached a steady value, the galvanometer needle comes back to zero; showing that no current is flowing through it, because no E.M.F. is being induced in B, since the strength of the magnet is not changing. Now if the switch Y is opened so that the current in A stops, the ring loses part of its magnetism. The galvanometer needle is now thrown in the opposite direction, showing that the weakening of the magnetism induces E.M.F. in the opposite direction in B. By reversing the current through A, the magnetism is not only weakened but is reversed, and the galvanometer gives a stronger deflection to the right, coming to zero again after the ring is fully magnetized.

If the current is rapidly reversed, so that the magnetization is continually changing, the E.M.F. in the secondary coil follows each change and an alternating current flows in the circuit.

The voltage in the secondary circuit equals the rate of cutting or changing lines of force. This is proportional to the product of the number of turns of wire in the secondary coil, the maximum number of magnetic lines of force through the coil and the rapidity with which the magnetization is reversed. See what follows if one of the factors is changed while the other two are kept the same. By using a large number of turns of wire in the secondary coil, a high E.M.F is obtained; on the other hand, by having few turns, a low E.M.F. is obtained. Also by using a high frequency, that is, by having the magnetizing current reverse many times per second, a higher E.M.F. is obtained from the secondary than if the alternations were slower. The number of magnetic lines of force equals the magnetizing force divided by the reluctance of the magnetic circuit. The magnetizing force (magneto-motive-force) equals 1.26 times the product of the current by the number of turns of wire. The reluctance is directly proportional to the length of the magnetic circuit, and inversely proportional to the sectional area and to a factor known as the permeability which varies with the quality of the iron and also with the strength of the magnetization. With a given quality of iron, the magnetism is increased by making the iron core shorter and thicker; but if too short, there will not be enough room for the coils. In the actual transformer of

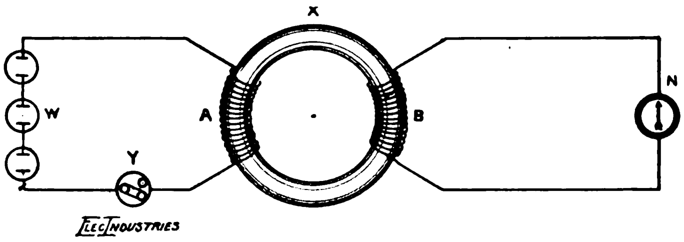

FIG. 25.

the kind generally used for supplying incandescent lamps, the iron circuit is as short and thick as possible while leaving sufficient room for the wires and insulation. The two coils are wound side by side or one outside of the other and the iron almost completely surrounds the coils as in Fig. 26.

The secondary coil is not the only circuit that is affected by the changing magnetization. Every piece of conducting material that lies within the range of the magnetism has an E.M.F. induced in it. In making a transformer it is therefore desirable to arrange all conducting materials such as iron, copper, etc., so that these various E.M.F.'s cannot cause current except in desired circuit. The iron core is therefore carefully laminated, that is, built up of thin sheets of iron which are insulated from one another by iron oxide, paper or enamel. Core and coils are generally placed inside of an iron box which does not need to be laminated, since very little of the magnetism strays outside of the core.

The same cause that induces the desired E.M.F. in the secondary circuit also induces an E.M.F. in the primary circuit. This induced E.M.F. in the primary is sometimes called a "counter electromotive force," C.E.M.F., or "back electromotive force," since it opposes the E.M.F. that causes the magnetizing current. It acts much like the C.E.M.F of a motor. The C.E.M.F. in the primary, like the E.M.F. in the secondary, equals the rate of cutting or changing the number of magnetic lines and is proportional to the product of the number of turns of wire in the primary coil, the maximum number of lines of force and the frequency. Since the E.M.F. of secondary and the C.E.M.F. of primary are caused alike, they are in phase with one another. They are also in quadrature with the magnetizing current since they are proportional to the rate of change of the magnetization. This change is least when the current is at a maximum and is greatest when the current is reversing and is zero. The magnetization is almost exactly in phase with the magnetizing current, so that the C.E.M.F. and secondary E.M.F. are almost 90° behind the magnetizing current.

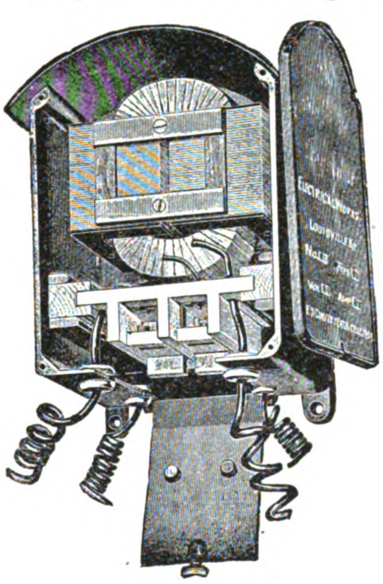

FIG. 26.

It is the C.E.M.F. in the primary coil that prevents a heavy current from passing through the primary. For instance, a certain transformer primary has a resistance of 22 ohms. When connected across an alternating circuit of 1,000 volts, the primary current is only 0.14 amperes. With continuous current it would allow 1000÷22=45.5 amperes to pass if the fuses did not melt sooner. With alternating current the C.E.M.F. opposes the impressed E.M.F. so that the effected E.M.F. is only 0.14×22=3.1 volts.

The "impressed E.M.F.," that is, the voltage on the primary line must overcome both the C.E.M.F. and the "ohmic drop," the drop being the product of current by resistance. The "drop" is in phase with the current, while the C.E.M.F. is almost at right angles with it. The impressed E.MF. may therefore be considered as divided into two components which balance respectively the drop and the C.E.M.F. If the primary coil had no resistance whatever and if there were no losses in the iron core, the impressed E.M.F. would be 90° ahead of the primary current, but the resistance and iron losses reduce this lead considerably.

The secondary current also has an effect in magnetizing the transformer core. Since the secondary current is in nearly the opposite direction from primary current, it tends to demagnetize the core. This would reduce both the secondary E.M.F. and the primary C.E.M.F., but a reduction in the latter would allow more current to pass through the primary and bring up the magnetization again. The reactions that take place are rather complicated and cannot well be explained fully without the use of mathematics. Experiment and analysis show that as more and more load is thrown upon the secondary so that the current increases, the primary current also increases proportionally to supply the energy needed for the secondary. As the secondary current increases, the primary current comes more closely into place with the impressed E.M.F. and so becomes greater. By this intimate relation the transformer is nearly self-regulating and the current taken by the primary is almost exactly proportional to that delivered by the secondary.

As the current taken from the secondary circuit increases, it is found that the secondary voltage falls off more or less. This is because the primary coil and secondary coil each has resistance so that there is more or less "ohmic drop" equal to the product of current by resistance, that is, of amperes by ohms. Another reason why the secondary voltage falls off is that there is more or less "magnetic leakage" in every transformer so that some of the magnetic lines of force set up by the primary do not pass through the secondary coil. In the case of the ring transformer, suggested in Fig. 25, it is easy to see that opposite currents in the two coils tend to set up opposing magnetizations so that magnetic resultant poles will appear between the two coils, and there will be a stray field that does not produce E.M.F. in the secondary. In the more compact magnetic circuits generally used in transformers, there is not so much chance for magnetic leakage and the secondary voltage is therefore more uniform. Most transformers have the primary and secondary coils wound closely side by side or one upon the other for the sake of avoiding magnetic leakage and so securing closer regulation.

On the other had, transformers are sometimes made purposely with considerable magnetic leakage. When properly so designed, the magnetic leakage will vary so as to keep the secondary current constant, and sometimes arc lamps are supplied with alternating current of constant mean strength by connecting the primary terminals of such a transformer with the ordinary 1000 or 2000 volt primary circuits used for supplying incandescent lamp transformers. But the more common method of operating arc lamps from alternating circuits is to use specially wound transformers of the ordinary pattern, but wound so as to reduce from 1000 to 2000 volts to about 30. With such transformers neither the current nor E.M.F. supplied to the lamp remains constant, but both vary continually as the carbons burn away and as the lamp feeds.

Many varieties of transformers have been designed for special purposes, such as adjustable choke coils or "reaction coils" for regulating current or voltage; conpensators for correcting the readings of a voltmeter so as to indicate voltage at a distant center of distribution "economy coils" for reducing voltage from 50 or 100 to 28 or 35 for operating arc lamps on same secondary circuits with incandescent lamps; adjustable "boosters" for raising or lowering the voltage on one or more of several feeder circuits supplied by the same alternator; welding transformers for supplying very heavy currents at low voltages as used for welding, forging or tempering metals; shunt coils, sometimes called also "choke coils," used in shunt with incandescent lamps when thirty to fifty are operated in series across the primary circuits. There are also what might be called compound or composite transformers with several circuits for changing from single phase to two phase currents or from two phase to three or more. Special transformers are sometimes used for changing from two or three phase currents of high potential to similar currents at low voltage.

In conclusion it may be repeated that alternating currents furnish an inexhaustible field for interesting study. In most cases the theory is vastly more complicated than the practice. It must be remembered, however, that most of the development of alternating current apparatus and its wonderfully rapid and succesful application to commercial uses is due primarily to those acquainted with theory and who have applied their mathematics toward extending real knowledge. With alternating current work one must "guide practice by theory and temper theory by practice."

Practical Electrical Testing.—II.

BY C. C. HASKINS.

The Tangent Galvanometer.*—A tangent is a right line projected from a point in the circumference of a circle or a curve, parallel to any diameter of that circle, or any diameter of any circle of which the curve is part. The dictionary definition of tangent of an arc is "a right line as *t*, *a*, Fig. 7, touching the arc at one extremity, *a*, and terminated by a secant *c t*, passing through the other extremity *o*."

We have seen that the action of current producing a magnetic field in which a magnetic needle is placed will tend to deflect that needle to the right or left, according to the direction of that current.

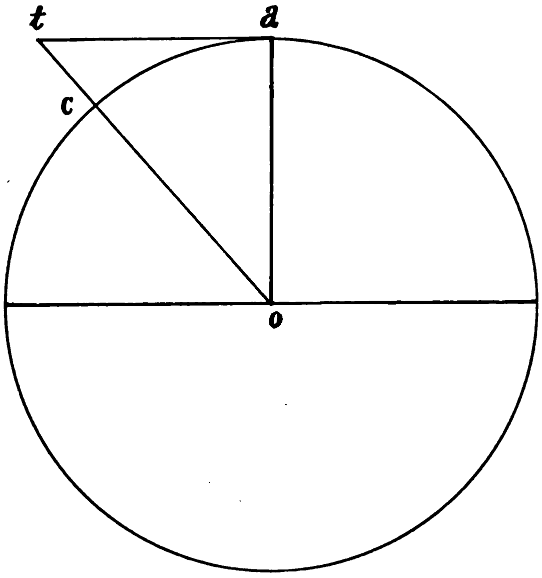

FIG. 7.

It is plain that the action of this magnetic influence will have reached its limit, (a point where it is opposed by an equal and opposite effect of the earth's magnetic influence,) when the needle is carried to an east and west position, 180 degrees from its normal position. If it is forced past that point by hand, it will immediately, if released, return to the east and west line.

From this we see that the strength of the magnetic field upon the needle is greatest when the needle is parallel to the coil, and lessens with each succeeding degree of deflection from that parallel; or, in other words, the greater the angle formed by the lines *a*, *o* and *t*, *o* (the angle at *o*), the less deflection there will be for a given amount of current passing around the needle; so that while a certain amount of current will give a deflection of 10 degrees, twice that amount will not give us a deflection of 20 degrees. But the strength of the current flow is directly proportional to the tangent of the angle of deflection, and with a table of tangents it is easy to work out, by the rule of proportion, the required result. With this form of galvanometer a known resistance is used to get at the necessary data on which to base the formula. Suppose we have a known resistance of 10,000 ohms, and that with our battery we find that through this resistance our deflection is 30 degrees. Now, having switched or changed our connections, with the same battery we get a deflection of 10 degrees over the line or unknown resistance. Turning to the table of tangents we find that the tangent of 30 degrees is .5774, and that of the unknown resistance is .1763.

The tangent of 30 degrees multiplied by the known resistance which gave us that deflection, divided by the tangent of the deflection through the unknown resistance will give the amount of that unknown quantity. Or, the tangent of the known resistance deflection is to that known resistance as the tangent of the angle of the unknown quantity —inversely—to the answer. Thus:

$$\frac{.5774 \times 10.000}{.1763} = 32.751 \text{ ohms.}$$

While for measurements requiring a considerable degree of accuracy the tangent galvanometer is a valuable instrument the necessity of working out the measurements is a drawback of a serious nature, where a matter of a few hundred ohms is negligible.

A form of tangent galvanometer, however, has been used extensively by inspectors, which is sufficiently accurate for many purposes where it is used. Where such an instrument is made up so that no appreciable deflection is shown by a current through an unknown resistance—one megohm, for instance—the "Skirmisher," as it has been called, does satisfactory work. With this instrument, if there is any deflection, the fault is one to be remedied, while above one megohm of insulation the needle will not move. Fig. 8 shows a plan of the "Skirmisher," in which W and E are the terminals. In measuring direct resistance one of these is attached to each terminal of the unknown. In measuring insulation from ground, either may be made a ground. G is the galvanometer; S and S′ are switches; B is a battery of four cells, numbered 1 to 4, while O is a contact to line without battery; R is a known resistance; D is a dead point on which the switch S′ rests when the instrument is not in use.

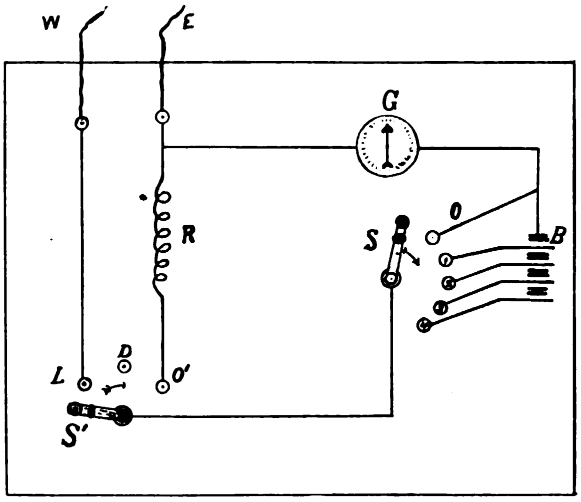

FIG. 8.

In using the skirmisher the switch S′ is thrown on L, and the switch S on 4. The circuit is now complete from W to L, S′, S, 4, through B, and G to E. If there is any deflection of the needle, we may approximately determine the leak by comparison with the deflection through the known resistance, R. To do this the switch S′ is thrown on O′, and we now have a short circuit through the battery, galvanometer and R. If the deflection is too much for the scale, we can reduce this by using less battery, say 2 cells by throwing S on 2 which is equivalent to doubling R. Sometimes we may get a deflection in the wrong direction, or one which is thought to be too great, and is suspected of being due to some other source of current. By reversing the line contacts at E and W, we will reverse this action, and the deflection will now be in the opposite direction. By throwing the switch S on O with S′ switched to line W, with E on the grounded side, we will get the foreign current through G. A leak across a cut-out from which the strips or plugs have been removed may sometimes be detected in this way.

The advantages of this style of galvanometer are its small compass, ease of handling and convenience for particular applications.

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* By an error Figs. 3 and 4 in the preceding number of this series of articles were transposed. Fig. 3 should have been Fig. 4 and Fig. 4 should have been Fig. 3.

Its disadvantages are its limited range of usefulness and its want of mathematical accuracy.

The Sine Galvanometer.—The sine galvanometer has been used in line testing to some extent, but is, if anything, less convenient than the tangent galvanometer proper. The principle of the sine galvanometer is that a definite proportion exists between the deflections obtained by the same battery through different resistances, these deflections being obtained by following the needle with the coil until the former becomes stationary; that is, the vertical coil which envelopes the needle turns on its upright axis independent of the needle. The strength of the deflecting currents are proportional to the sine of the angle of deflection.

The Wheatstone bridge is doubtless the best, all things considered, of the galvanometer combinations, for ordinary insulation measurements. The handling is simple, the results accurate, and the instrument in a compact form is quite portable and convenient.

In a recent number of Electrical Industries* a cut of the bridge, and a description of its action was given.

There are many forms of bridges, somewhat different in arrangements but all depending on the same general principle. A form designed originally by the writer, has come into quite general favor, owing to the convenience of its arrangements and its compactness. Fig. 9.

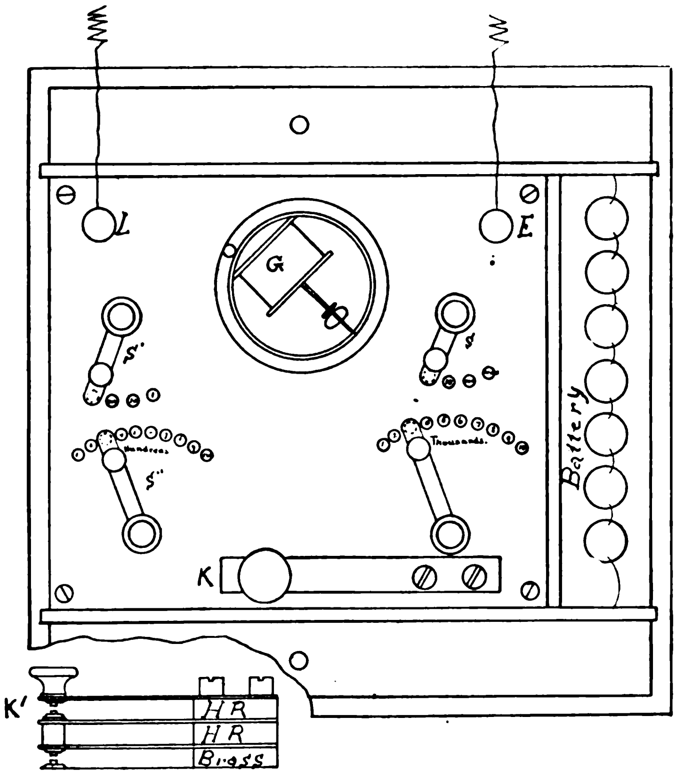

FIG. 9.

This bridge has some peculiarties which have been suggested by experience. It combines in one box the bridge, galvanometer and battery, and has no plugs, the contact being made by a switch arm on each of the sides. Making tests in all sorts of out-of-the-way places it was not unusual with a plug system, to drop one of these little essentials, sometimes in a new building where its recovery was, to say the least, problematical. The necessity for two or three separate instruments is done away with; there is much less to adjust and but one pair of wires to couple up.

The combination, which is a pure inspector's set, is not good for much else, inasmuch as coils of the lower denominations are not included in the third side, marked "hundreds" and "thousands." The same principle, however, would be applicable for all purposes where any Wheatstone is available, by the addition of small coils.

The principle is the same in this as in other bridges—only the arrangement of the wires is different. One section of battery only is shown. The covers to the other two are not removed.

At S and S' we have the two sides of the bridge which establish the proportion. The first we will call the multiplier, the second the divisor. There are two other sets of coils of ten each. One of these S'' is made up of coils measuring 100 ohms each, the other S''' of ten coils of 1000 each. These twenty coils make the third side of the instruments, and the unknown—we will call it the *line*—will be the fourth side, which we desire to measure the insulation resistance of. We will ground one terminal of the instrument E—but it is immaterial which—and the other terminal L, we will attach to the line. Now, unless there is a leak to earth on the line, we will not have a perfect circuit when we close the key K, but if there is a leak, the amount of current escape over that leak will be proportional to it, according to that law of Ohm which is so often quoted, and too little understood—that the current flowing over any conductor is inversely proportional to the resistance. The more current there is flowing over that leak the greater will be the action on the galvanometer, G, and to check this action we introduce resistance in the third side, until when we close the key there is no movement of the needle. We now have a balance, and in order to get the fourth, or unknown side of our bridge, we multiply the third term by the second and divide this sum by the first term. It is a simple example in the rule of three, or proportion. K is a double key, shown in detail at K', which closes the two circuits through the galvanometer and battery.

For example, if in the first side we introduce 100 ohms by turning the switch on that contact, and in the second we introduce 10 in the same way, and we find a balance by turning the thousand switch on 10 and the hundreds switch on 6, which will make a total of 10,600 in the third side, we will have all the necessary data to find the fourth, or unknown side, thus:

10,600 × 100 = 1,060,000. Divide this by 10 and our answer is 106,000 ohms insulation resistance, and now we have this proportion: 10 : 100 :: 10,600 : the unknown.

In others words, when A (10) bears the same proportion to C (100), that B (10,600) does to the answer, the needle will not move when the key is closed to send current to line. For equal amounts of current flow over the several paths, and no current deflects the needle.

If with a bridge constructed so as to give more accurate measurements we desire to measure the ohmic resistance of a wire or other conductor, we omit the ground and measure directly through the conductor, making a contact with each terminal. For instance, to measure the resistance between a person's two hands, through his body, he would place one hand on each terminal.

For still more particular tests, or for very high resistances, the reflecting galvanometer is used.

Lights Out.

On Friday, November 15th, an accident at the Elizabeth St. station of the Brush Electric Light Co. left the lower part of New York in darkness. An elbow in an eight-inch steam pipe burst and filled the station with steam. The steam was shut off as quickly as possible, but not before it had injured all belts in the station. The belts were repaired as quickly as possible, but no satisfactory service was rendered that night.

On November 5th lights in the business district of Chicago, furnished by the Chicago Edison Co., were noticed to go out gradually at 5 P. M., at a time when the load is heaviest. The burning out of some large feeder cables which had been injured by the settling of the conduit, was the cause of the trouble. In about three-quarters of an hour the circuit was restored and the lights burned with their usual regularity. This company also furnishes a large amount of power for elevators, cash carrying systems, etc., all of which were at a standstill until the current was again turned on.

An effort is being made to reorganize the Detroit Electrical Works. It is said the old plant could be purchased for about $50,000, or a fraction of its original cost. Jas. I. Ayer, Cameron Currie and Thomas Jerome are interested in the movement.

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* See September number, page 249.

The Largest Street Railway Car House in the World.

One of the important parts of every street railway system is the department having charge of the rolling stock. On the larger railway systems of the great cities of this country where not only an immense number of cars are in service every day, but the changes of the season demand a change in the cars, necessitating the carrying of an almost duplicate equipment, this department assumes immense proportions. The severe climate of most of our cities is so destructive to the rolling stock that car barns are considered good investments. It being advantageous that the barns be located convenient to each line using them, the investment for real estate and building forms are important item in the cost of such a road.

The car barn illustrated in the accompanying engravings, is unquestionably the largest in the world. It has a floor area of nearly ten acres, is 700 by 200 feet and three stories high. It has a storage capacity of one thousand cars, and accommodates them in such a manner that all can be quickly taken out or put in. The building also contains the repair department, with its extensive repairs and tools for quickly restoring the disabled car to a serviceable condition. This barn, which was built by the Brooklyn Heights Railroad Co., of Brooklyn, N. Y., is the depot for six lines. Its site is such that each of the three floors has an entrance from the street. As shown in Fig. 2, the first floor is on a level, with the street in the fore-ground, while the street in the rear is on a level with the third floor. The second floor has entrances from the street at the side. The advantages of such a location are great. Railway men who are accustomed to raise the cars to the upper floors of their barn by elevators will at once see the advantages of this barn. The upper floor has fourteen tracks running from the street into it, and there are eighteen tracks inside. Transfer tables, front and rear, also assist in shifting the cars about.

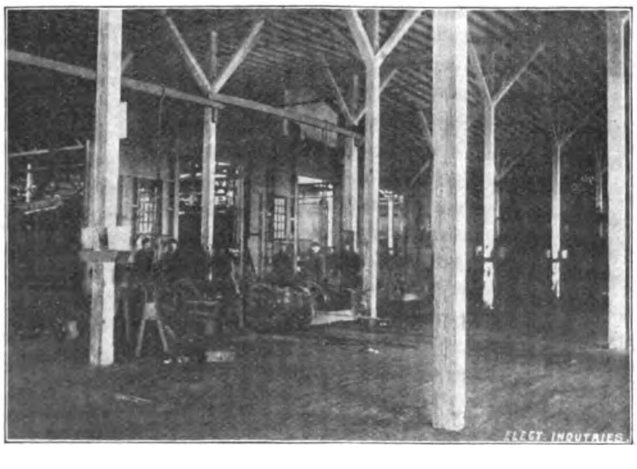


FIG. 1.—THE LARGEST STREET RAILWAY CAR HOUSE IN THE WORLD.

Elevators are not needed, except for conveying freight from one floor to another. For this purpose an Otis elevator is used. The company has contracted for a flush transfer table operated by an electric motor which is now being built by the Johnson Company. The barn will then be fully equipped as far as apparatus for the storage of cars. It is often important to be able to get cars out quickly as in the summer, when sudden storms are liable to occur, against which the open summer cars offer little protection.

The pit room on the upper floor is 145 by 200 feet and will accommodate 70 cars. This room is heated by steam, lighted by electric lights, and can be shut off from the rest of the building when desired. The facilities for repairing either the car or its equipment are ample, and in this department forty men are constantly employed. The work requires of the men an ability to do temporary as well as permanent repairs and a skill not required in original construction. The equipment of this department is, however, sufficient almost to construct a car from the beginning. Mr. Chas. H. Cole is the foreman of the electrical repair department.

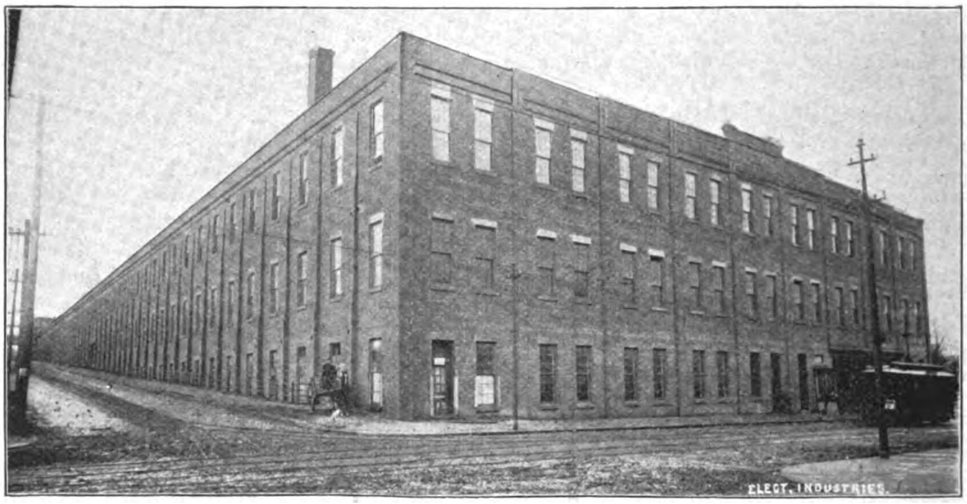


FIG. 2.—THE LARGEST STREET RAILWAY CAR HOUSE IN THE WORLD.

The building is a substantial brick of mill construction. It is equipped with a fire-alarm system, installed by the American Watchman's Time Detector Co., which gives instant notification of a fire to the department should one occur.

In Fig. 1 is shown a corner in the repair department where a group of men are working upon car trucks. The parts of the car, especially the motors, being heavy, hoisting devices are necessary to remove them; therefore such arrangements as are shown, which can be put wherever required, are used for raising the heavy parts.

The officers of the electrical department of this company are as follows: Chief engineer, M. G. Starrett; superintendent of motor equipment and repairs, J. T. Whittlesey, and superintendent of line construction and maintenance, H. M. Brockbank.

The Galena Electric Light Plant.

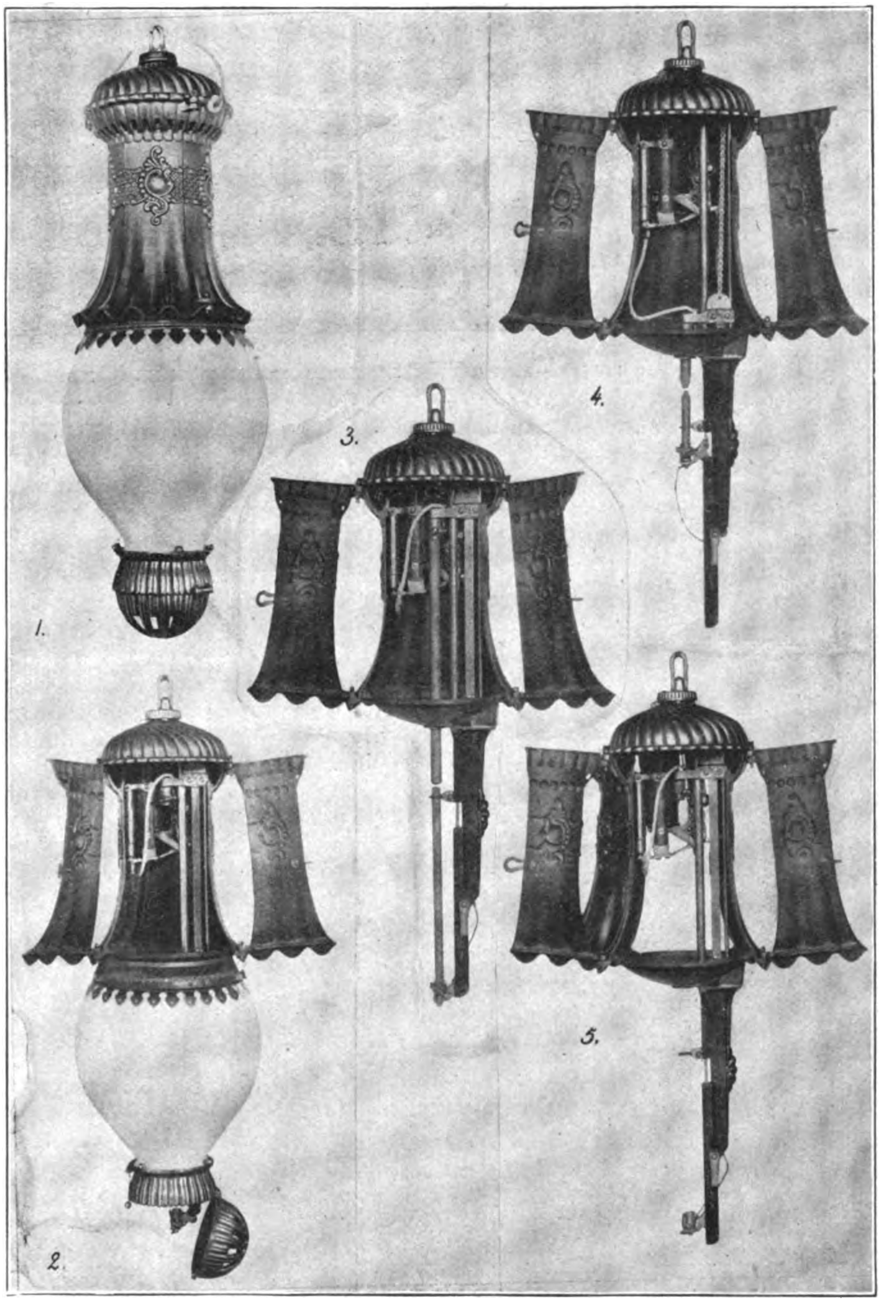
The plant of the Galena Electric Light Co., Galena, Ill., was started on November 1. This plant has recently been built by Mr. W. L. Prim, the owner, and through his efforts the city has been induced to light its streets with arc lamps. The innovation attracted a considerable attention and the starting of the plant was made the occasion of a reception at the station, at which Mayor J. G. Schmohle and the committee of aldermen having in charge the matter of lighting the city were present.

There was considerable opposition to the lighting of the streets by electricity, but since the change has been made the remarkable contrast has quieted every complaint. The arc lamps are operated by a Brush machine which is driven by a Corliss engine. The plant started up smoothly and has operated very satisfactorily, showing the installation to have been well done.

The Review of Reviews for December in its "Progress of the World" department, plunges as usual into the discussion of important current topics. The assembling of the Fifty-fourth Congress, at home, and the disturbed condition of Turkey and some of the European powers at this moment present questions which call for extended comment this month. The editor also devotes several paragraphs to the boundary dispute between Great Britain and Venezuela, and the results of the recent elections in various States are reviewed and summarized.

The Adams-Bagnall Arc Lamp.

In a study of the arc lamps that have been and are now on the market one is struck with their similarity. With few exceptions the builders of arc lamps have followed the ideas of the original inventor with such modifications as have suggested themselves. The result is that arc lamps have retained this resemblance. The lamp recently placed on the market by the Adams-Bagnall Electric Co., of Cleveland, Ohio, is therefore, an innovation which is a relief to the eye and a pleasure to all who delight in the products of the true inventor. Neat, symmetrical outlines unmarred by rough proportions render attractive this type of lamp.



FIGS. 1, 2, 3, 4 AND 5.—THE ADAMS-BAGNALL ARC LAMP.

The accompanying cuts show this lamp in a number of ways. Thus, in Fig. 1, is shown a view of the complete lamp as it appears when ready for use. Fig. 2 shows the lamp as it is opened by the trimmer to place the carbons in position. It will be noted that it is not necessary to remove the globe as in the usual style of lamp. The trouble to the trimmer is avoided and time saved. This method also renders unnecessary the many devices for lowering and holding the globe while lamp is being trimmed. In Fig. 3 is shown the lamp trimmed but with globe removed to show the carbons ready to start on a 14 hour run. In Fig. 4 is the same lamp after burning 14 hours. The lamp open ready for inspection is shown in Fig. 5.

The accessibility of all parts, the quickness with which it can be trimmed, neat and ornamental appearance will be noted from these views of the lamp. It is but 32 inches high and burns from 14 to 18 hours. It is a single carbon lamp and has but one side rod, so that a shadow is thrown in but one direction. When used for street lighting this side may be turned toward the pole or building and by that arrangement a uniform distribution of light will be obtained.

A valuable feature in the operation of the lamp is the cut-out. It is well known that there are some standard lamps on the market which operate and cut out perfectly at any reasonable number of amperes, provided that the lamp has previously been adjusted for the special number of amperes. The A.B. lamp will operate and cut out perfectly at any number of amperes from five to ten without any adjusting whatever. The accomplishment of this feat makes it feasible for the station manager to run either 1,200 or 2,000 candle power lamps to suit his convenience, with no change excepting the ampere output of his dynamo. Since the invention of the cut-out itself some twenty years ago no step in its development has been of such importance. Second in importance only to the feature just mentioned is the fact that the series lamp can be changed instantly into a constant potential lamp and that again into an alternating lamp simply by an exchange of spools. All of the working parts of each lamp are mounted on one frame, which is attached to the lamp casing by a single bolt and nut. By loosening this nut the working parts of the lamp are removed and those of another substituted. One style of lamp only need be carried in stock by the station manager and with the addition of several kinds of spools he will be prepared to furnish a lamp for any kind of circuit.

The A.B. lamp will be furnished in any finish desired, whether black Japan, yellow brass, seventeenth century brass, oxidized brass, oxidized copper, oxidized silver and aluminum. This provides an arc lamp good enough to hang in a parlor, it being possible to match any style of gas fixture or decoration. The aluminum lamp weighs only nineteen pounds complete. The casing being of cast-iron provides a solid background for ornamentation, giving the lamp a dignified, substantial appearance.

The A.B. lamp is the direct result of several months of close study and application by the engineering corps of the Adams-Bagnall Electric company, headed by T. E. Adams, the well known inventor of the Brush-Adams lamp. The results obtained point to a lamp which will certainly take its stand at once among the leading lamps of the day, which assuredly means success for this company.

Accompanying this lamp the company has an excellent line of accessories, including hanger boards of such a designs as comform with the rules of the fire underwriters and city ordinances. It is strong, durable, easily put up and always on duty. This company in both its incandescent lamps, its arc lamps and devices has produced new and improved designs which are a credit to the designing engineers of the company who have long possessed a high reputation through their work with other companies.

Obituary.

Thomas McCoubray, at one time secretary of the National Electric Light Association, died on December 5th. Mr. McCoubray was born in the District of Columbia, May 20th, 1847 and spent his youth in Baltimore, Md., and graduated from Baltimore city college. He has held several positions of trust in connection with the commercial side of electrical interests and has lately been connected with the development of the Auto-Telephone system.

Increase In Capital Stock.

The board of directors of the Phœnix Carbon Company of St. Louis has voted to increase the capital stock from one hundred to two hundred thousand dollars. This company is incorporated under the laws of the state of Missouri and the present capital stock was fully paid up. This has been found inadequate to meet the demands of the growing business and the increase has been voted to be expended in improving the manufacturing facilities.

The Calumet Electric Railway Co., Chicago, has leased lines and built a number of important stretches of track which will give it most excellent terminals, making connection with the railways to the south, reaching Hammond and neighboring suburbs, and with the city lines on the north. From these roads passengers are carried to West Pullman, Roseland, Kensington and to Auburn Park.

The Oldest Electric Railway in England.

In a recent issue of this journal one of the most recently constructed English roads was illustrated. The illustrations presented herewith are on the line of the oldest electric railway in Great Britain. This road is located at Blackpool, which is about thirty miles north of Liverpool, on the Irish sea. The railway was constructed in 1884, but its equipment has been changed as improvements in electrical machinery have been made. The road was built and operated for seven years by a private company, but in 1891 the Blackpool corporation took advantage of a provision in the franchise and purchased the road and its equipment.

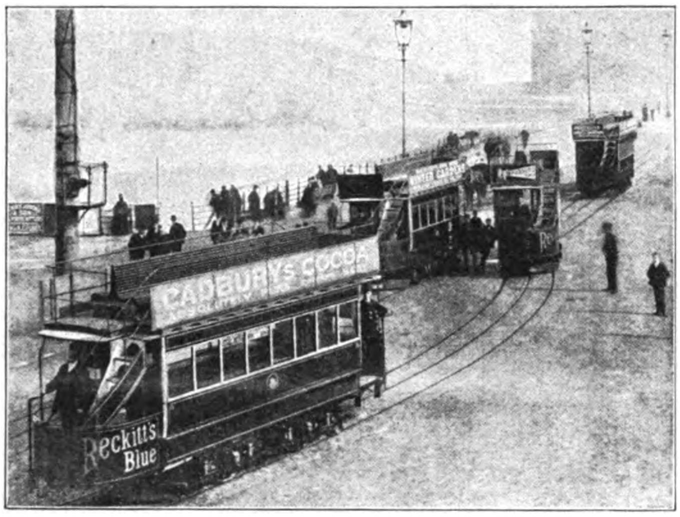


FIG. 1.—THE OLDEST ELECTRIC RAILWAY IN ENGLAND.

It is a conduit road, built according to the designs of Mr. H. Smith, under whose supervision the road was constructed. It is but two miles long, has ten cars, and was capitalized at $100,000. The road has been quite successfully operated. Blackpool, being an important resort, has during certain seasons a large transient population, and from them this road draws a large part of its patronage. There are consequently a number of months each year when the patronage is light. During the past year the road has carried over one million passengers, which gave to the corporation a small margin of profit.

In Fig. 1 is shown a view of cars at Talbot Square. These cars are of a pattern which has been adopted and successfully used. Recently two new cars like the one shown in Fig. 2 have been purchased. These are mounted on two trucks, and have a seating capacity of 82, 46 outside and 36 inside. The upper seats, from which are obtained the best views of the sea and neighborhood, are very popular. This line runs along a beautiful promenade overlooking the sea, and is usually well patronized. The road carries as high as 12,000 passengers in a day. The conditions are unusually favorable for the success of such a small road.

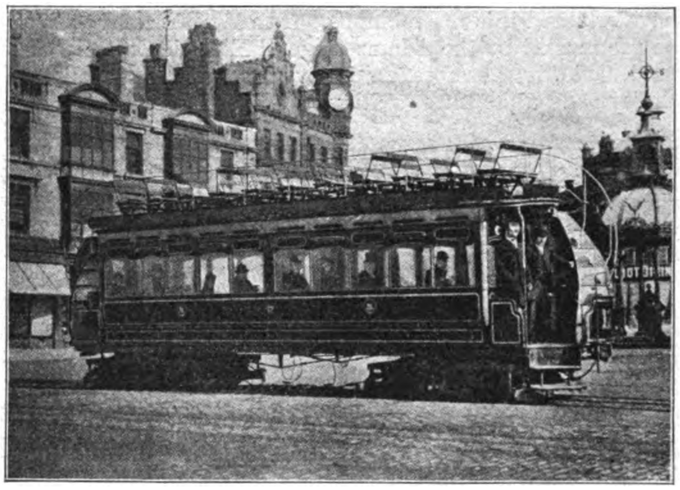


FIG. 2.—THE OLDEST ELECTRIC RAILWAY IN ENGLAND.

The reader will also notice from the engravings how well the opportunities afforded by the cars for advertising are taken up. These cuts are taken from Lightning (London).

A New Design of Multipolar Dynamo.

The multipolar dynamo shown in the accompanying cut is one of the new designs being built by the Triumph Electric Co., of Cincinnati. It is well proportioned, with broad base and center of gravity low down. This insures a firm and smooth running machine. As will be noted from the view of machine shown the outlines are neat and graceful and impress one with the good taste and skill of the designer. This is further shown in the outline drawings which present the different outlines of the dynamo. The field proportions and magnetic circuits can be traced together with the armature and the shaft bearings.

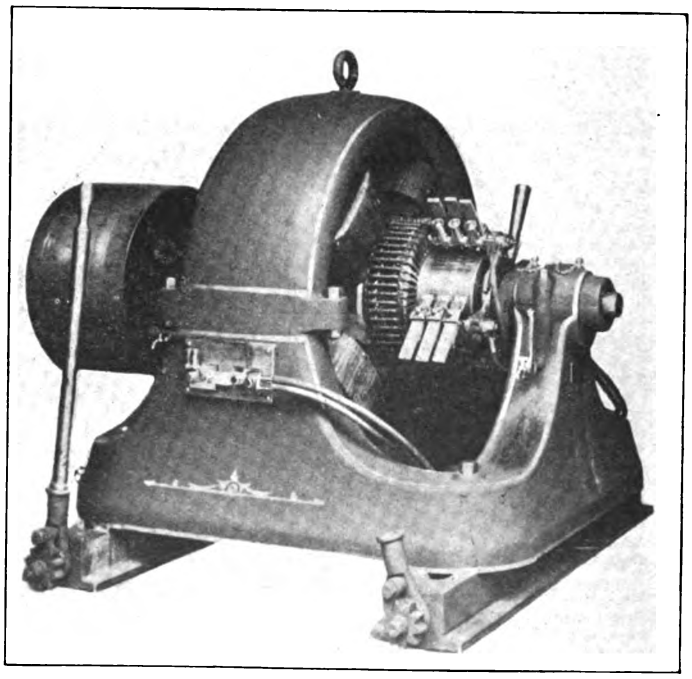
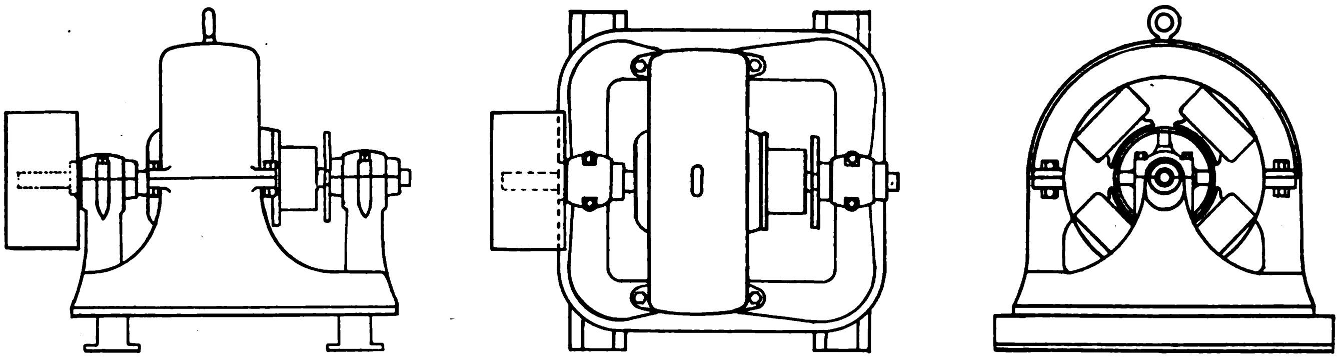


FIG. 1.—A NEW DESIGN OF MULTIPOLAR DYNAMO.

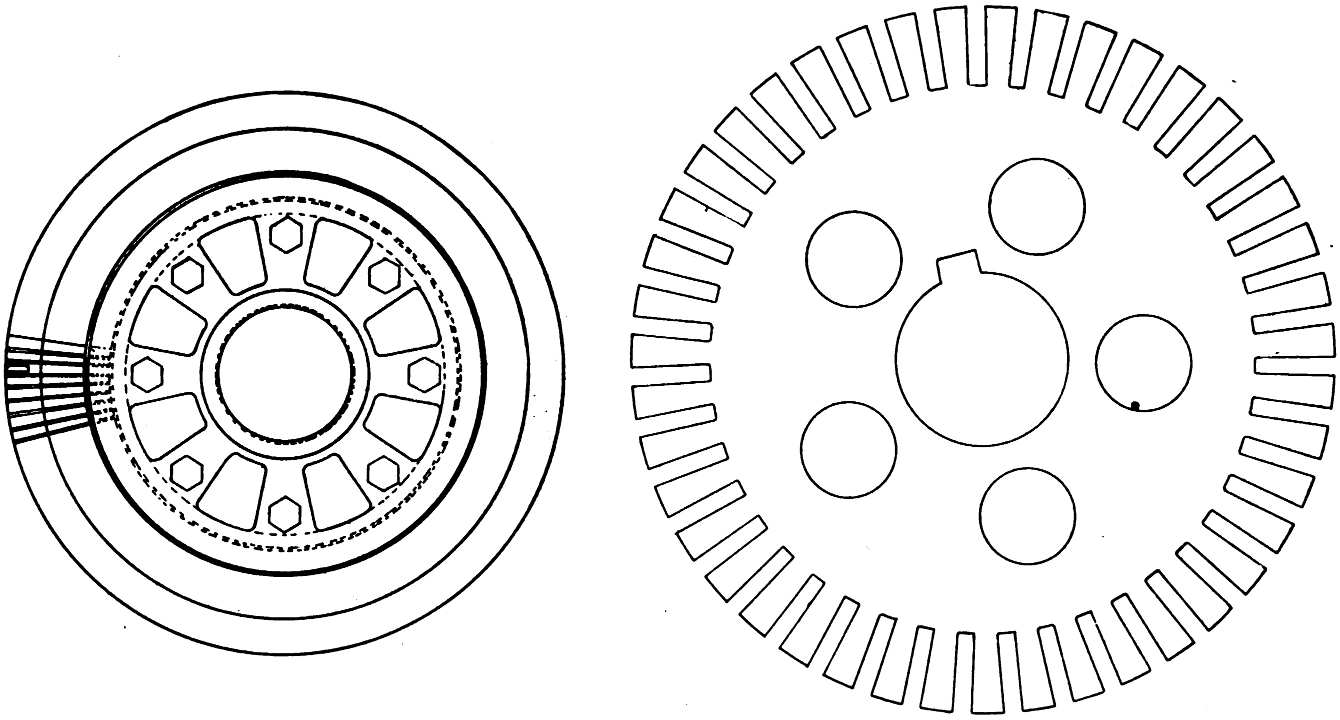
The dynamo shown here is of 45 kilowatts capacity but it illustrates the design of machines through a considerable range each side of that. The description of the special and improved features of this machine will apply to others sizes of both dynamos and motors.

The chief point of superiority claimed for this machine is the construction of the magnetic circuits by which a greater efficiency is obtained. The pole pieces are laminated iron to which are fitted cast iron shoes. By the use of cast iron shoes the machines will bear a full load being thrown on or off without changing the brushes and no sparking will result. This is obtained by the conductors on the armature coming out of a field which gradually weakens at the edges. The theory of this is that the laminated iron runs at 85,000 lines of force to the square inch while the cast iron practically saturates 60,000. The design of the shoe is such that it runs out into practically no lines at the edges.



FIGS. 2, 3 AND 4.—A NEW DESIGN OF MULTIPOLAR DYNAMO.

The laminated pole pieces are cast solid in the crown proper which is soft cast iron of good dimensions. Laminated iron has been generally used for armature cores but not until recently has it been used to any great extent for pole pieces. By its use the size of machines of a given output has been reduced and more efficient machines have been constructed. The employment of the laminated iron for the pole pieces gives also a greater space for the field winding. The yoke or frame can thus be brought closer to the armature and the magnetic circuits are shortened. Thus, as nearer the entire power applied produces effective work in the dynamo, its efficiency is raised. This point has been kept constantly in mind as the details of this dynamo were worked out.



FIGS. 5 AND 6.—A NEW DESIGN OF MULTIPOLAR DYNANO.

Fig. 6 shows one of the armature core disks used in this dynamo. It has besides the center hole for the shaft five other holes as shown. When placed on the shaft these holes form openings through the length of the armature core. A thorough ventilation is thus obtained which keeps the temperature of the armature uniformly at a point which gives a low resistance to the copper conductor. While these openings are located so as to render service to all parts of the core, they do not replace enough material to reduce materially the core.

The periphery of these disks are punched so as to form slots for the armature windings. These slots are insulated before the windings are put on, so as to guard against the least liability to a short circuit through the core. The latest ideas are followed in the matter of insulation and the same thoroughness of construction is followed as is manifest in other parts of the work. Rigid tests are made before dynamo is pronounced finished to satisfy the company that the machine is perfect before leaving the factory.

Another interesting part of this dynamo is the commutator upon which so much depends in the perfect running of the dynamo. In Fig. 5 is shown the outlines of the commutator. The outer rings represent the periphery of the upper and lower parts of the commutator segments. The head is shown in outline and bolts holding the commutator together. At the side the individual bars with insulation between is indicated. This insulation is pure mica about three hundredths of an inch thick. The ends of segments are insulated by heavy rings. One segment is shown as it is milled to receive the terminal of one of the armature windings.

In tests of this machine under full load and over loads up to 25 per cent the temperature raised but slightly. On a five hours' run with a load 25 per cent in excess of the rated capacity of the dynamo its temperature was but 32 degrees above the surrounding air. The ventilated armature and commutator together with the other special features of the machince have combined to produce these results. This dynamo is but one of several types built by the Triumph Electric Co. and since a recent purchase of the equipment of another company, another entirely different line of machines will soon be placed on the market.

The Gates Multipolar Dynamo and Motor.

A study of the engravings presented herewith will give one of the best ideas of the dynamos and motors built by the Gates Electric Manufacturing Co., Chicago. In Fig. 2 the many parts that make up one of these machines are shown as they are gathered ready to be assembled. The field ring is neat in outline and well proportioned. Being constructed in two sections each part is of a size easily handled. The armature core is shown as it is put together. The sheet iron sections are mounted on a sleeve from which the shaft may be withdrawn at any time. The pole pieces are large, with shoes cast in the same block. The bearings and pedestals are separate from the base and of good dimensions.

In Fig. 1 is shown the fields with the coils in place, the bearing and brushes removed and the armature ready to be put in place. In Figs. 3 and 4 completed machines are shown which are now in constant operation. Fig. 3 is a 25 kilowatt multipolar dynamos operating at a speed of 850 revolutions per minute. Fig. 4 is a 75 kilowatt 250 volt motor running 500 revolutions per minute. This motor has been in operation for some time at the works of Fraser & Chalmers, Chicago.

The designers of this line of dynamo electric machinery are men of experience in the production of such machinery and also in its operation and installation. These machines. therefore, will be found to possess a number of features facilitating both their installation and operation. The removable pedestals permit the armature in the larger machines to be placed easily in position.

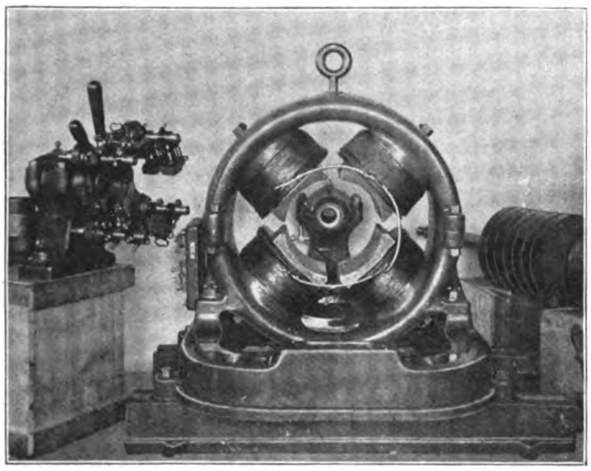


FIG. 1.—THE GATES MULTIPOLAR DYNAMO AND MOTOR.

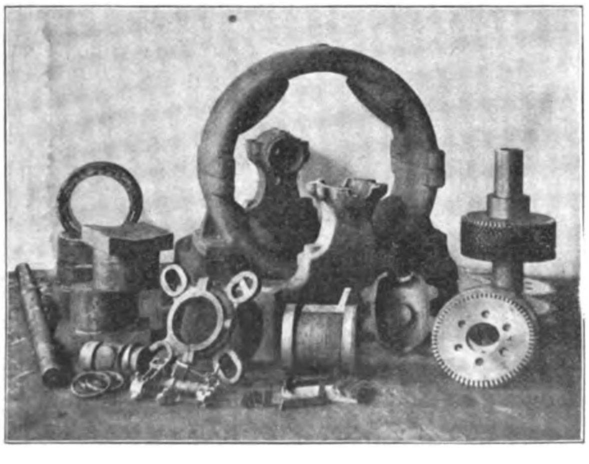


FIG. 2.—THE GATES MULTIPOLAR DYNAMO AND MOTOR

Among the important features might be mentioned the flexible bar windings of the armature, placed in the insulated slots of the armature core. These windings are securely fastened to the commutator segments which are also secured in a novel manner. The spider on which the segments are mounted is shown in Fig. 2. Upon this they are secured so that any one segment may be removed without taking the commutator all apart. It often happens that a segment will develop a soft spot and it becomes necessary to replace it by a perfect one. To do this requires but a short time as in this commutator each segment can be separately removed.

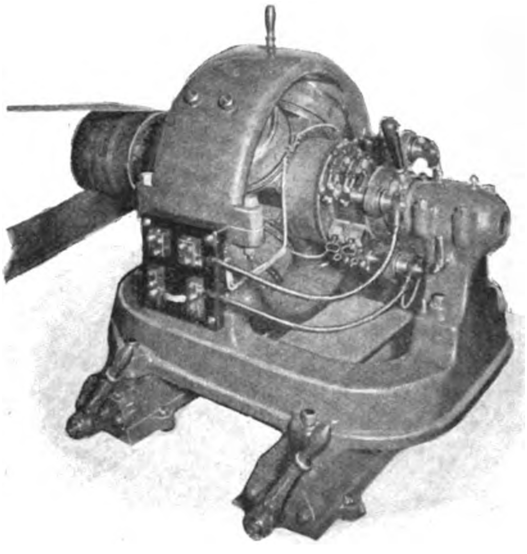


FIG. 3.—THE GATES MULTIPOLAR DYNAMO AND MOTOR.

Carbon brushes are used and are held by an improved holder as shown at the left in Fig. 1. The bearings are self-oiling and self-aligning ball bearings. The bearing journals are made of Ajax bronze metal. The core discs are charcoal iron. The shafts are forged steel. The open hearth steel plate pieces are bolted to the magnet ring so that the field coils may be removed without taking out the armature.

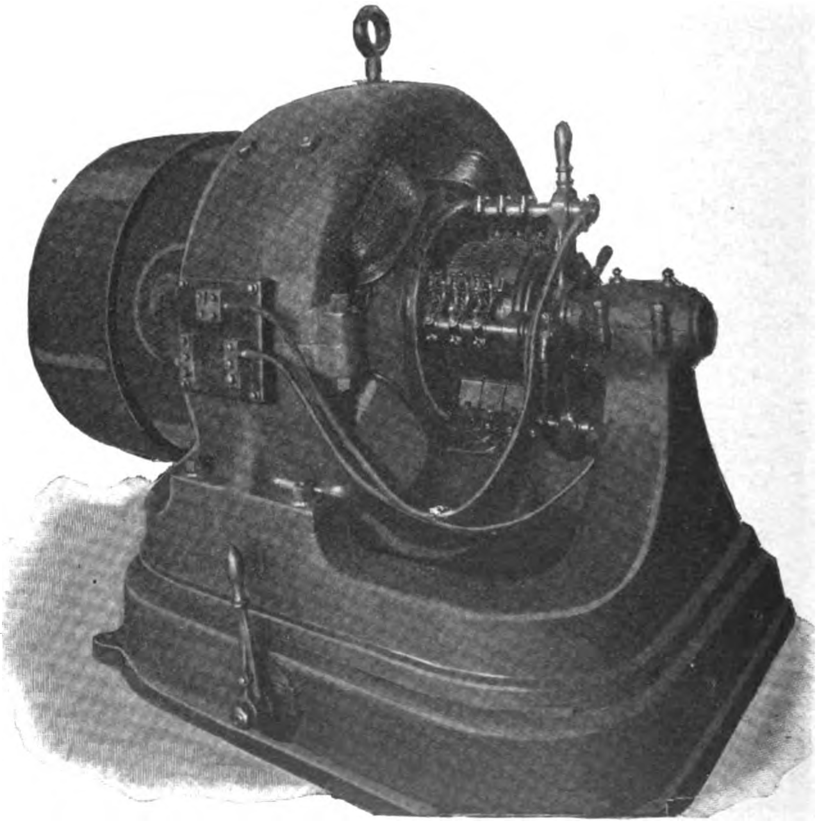


FIG. 4.—THE GATES MULTIPOLAR DYNAMO AND MOTOR.

LESSONS IN PRACTICAL ELECTRICITY.

[This department has been opened with a view to affording information of an instructive nature on the subject of electricity. The articles are designed to assist ambitious workers to become proficient and to be able to perform their duties more intelligently. While some of the articles will be of an elementary character they will be inserted only as an aid to the better understanding of practical problems.]

A Knowledge of Draughting Necessary.

No better instructions can be given a mechanic than a well-made plan or drawing of the work to be executed. The complete datum is before him; he does not have to rely on memory or consult his superintendent. A good idea of what is to be done can be gotten before he commences its execution. He does not start out with a few instructions which are followed out in complete ignorance of what the work is to be when completed, but conducts every step as a part of the whole. This method permits fewer errors and when mistakes occur it is an easy matter to place the blame where it belongs. But unless the workman understands drawings the finely executed drawing is useless in his hands.

The writer has known instances where the time of the foreman was taken up in reading and interpreting for the men under him the plans of the work in hand. The workmen looked upon the drawings that came in with as great awe and mystery as the ancient Egyptians looked upon the charts of the astrologers. The foreman had to give the sizes, the dimensions, and explain the whole character of the work. The men had served a long time in the shops, but unless the foreman was there they were helpless beyond a certain point.

Later a change began to be noticed in this shop. Some of the younger men and boys who came in had learned in the schools mechanical drawing, and as they became proficient in the trade were able to take the plans of the work and complete it without further instruction. The result was that the younger men got the more complicated jobs, while the old hands were put on standard goods and stock supplies. The new men got the better wages and the old hands were crowded out.

As a rule electrical mechanics will be found better prepared than the average, but many of them looking for better positions wonder why the advancement doesn't come; why they are not more successful. In a majority of cases it would be answered: because they did not understand mechanical and architectural drawing; were unable to place their ideas on paper, and gather those that some one else had placed on paper. A short time ago a wireman was sent to the proprietor of a store to put in some lights for him. The store was being remodeled and incandescent lights were to be put in. The proprietor gave the wireman the plan of the store, with the location of the lights marked. One of the lights he desired put in another place; so he showed the wireman where he wanted it. He then left the plans with the man. He returned a couple of hours afterwards and found the workman seated on a box by the side of the plans waiting for the proprietor to show him where the other lights were to go, the first light having been put in. The proprietor called his attention to the plans, but could not make him understand from the plans where the lights were to be located, and had to send some one to mark the location of every light. This wireman, probably, wondered why he did not get better wages and a better position.

One of the first things to be learned by a young man entering electrical pursuits is drawing. It matters not the exact line of work he may take up, the knowledge will always be useful. Whether connected with the manufacture, installation, operation or the sale of electrical machinery the one with a knowledge of mechanical and architectural drawing will have the advantage. In the manufacture and installation of electrical machinery and systems of light and power, the plans are a complete guide of the work. To the salesman they furuish the data for his estimate of the cost of the equipment. In the operation of a plant certain methods of construction and repair and certain kinds of appliances are adopted as standards. Plans show these methods. Material is required at the station, and a neatly drawn plan gives to the foundry or the machine shop all the information for its construction.

It is difficult for the ordinary person to express in words a sufficiently exact description of an object, a mechanism more or less complicated, so that the listener shall have in his mind a clear and distinct image of the object. An illustration or drawing of the object gives an idea of the object almost as good as the object itself. Therefore drawings and illustrations should always accompany the description of a machine, a system of construction, etc. Books that treat of mechanical or electrical subjects at the present time are filled with illustrations. Sometimes these illustrations are reproductions, often the working-drawings. It is, therefore, necessary in studying any subject of this kind that the reader be acquainted with the principles, signs, etc., of drawings.

The demand for skilled workmen was never so great as at present. The time has passed when positions open to the untrained. The present also affords superior advantages of education. The manual training schools are found in every city and evening classes are opened for those who cannot attend the day classes. The price of subscription periodicals has been reduced to almost the cost of the postage. Facilities for learning have multiplied on every hand. Ignorance is no longer excusable. If you are engaged in the electrical industries do not fail to take advantage of every opportunity to increase your knowledge. If you contemplate engaging in electrical pursuits, do not neglect a thorough preparation. Mathematics, mechanical drawing, electricity and mechanics should form a part of your studies. Electric systems and appliances will never be thoroughly understood until after a knowledge of these subjects has been obtained.

Wrinkles in Electrical Practice.—V.

BY ALBERT SCHEIBLE, M. E.

Show Window Wiring.—When the holiday season comes along, the ordinary pendants or ceiling lights generally used for lighting show windows seem commonplace. The proprietor of the store may not need any more light, but he wants something out of the ordinary, something that will be new for his store and perhaps new in the town. And whatever he wants is needed quickly; so it takes not only a skilled wireman, but one that is well posted. The wireman should know the quick methods of window-wiring, and if possible some of the " wrinkles " which help to produce striking results with a small outlay of time and material. Let me mention a few of these:

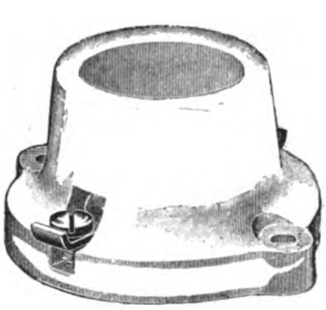


FIG. 1.

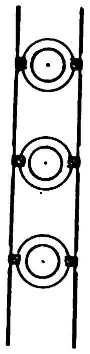


FIG. 2.

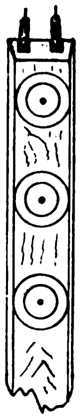


FIG. 3.

(1) Border Lights.—Perhaps a border of lights around the window will suit the storekeeper's fancy. For this purpose the " special cleat receptacle," designed by my friend, Thos. G. Grier (and now sold by all large supply houses), is a most handy socket. You can readily see from the sketch of it (Fig. 1) that it has exposed terminals which readily connect to the wires. All you need to do is to fasten your receptacles in place with wood screws, stretch your

wires temporarily, scrape off the insulation for about half an inch opposite each terminal and then clamp the wires in place. The result is about as shown in Fig. 2, making a neat and serviceable border. But suppose you have iron columns instead of wooden ones, or suppose you happen to be in a large city where the use of receptacles with exposed terminals is prohibited—what then? Then you can get a so-called "concealed receptacle," which allows the wires to enter from behind. This style of receptacle is now made with a small base so as to fit the top of a narrow two-wire wood moulding. The handy "wrinkle" in this case consists in getting a moulding with backing and first clamping this backing to the wall or column. You can then screw the receptactes to your strip of moulding, and run a pair of short wires from each one through the moulding. Then you can lay your long (or feeder) wires in the ground, mark the places where you want to connect to each of the short wires, scrape off the insulation at each place and make your joints. After you have taped your joints, you have your row of sockets all wired and ready to be fastened to the backing. The beauty of this method is that it allows you to put up your row of sockets in any position where you can fasten your backing.

Now, if the ceiling is so high that a row of lights along it would be too far off, you can try a simple but effective "wrinkle" with such moulding-supported receptacles. Cut your piece of moulding a little longer than the distance across the window, bend it into a long curve, and fit up a firm support for each end. It will then form a shallow arch, and your row of lamps lining this arch will make a more striking impression than they would if fastened to the horizontal ceiling. If you want a more striking curve to the moulding you can steam it before bending, but you must then dry it before putting on the receptacles and wiring them up. If the window is a deep one, you can have a couple of these arches crossing each other, as in Fig. 5, so to form a sort of roof or dome. Other pretty effects can be produced by using bent moulding as a support for both wires and sockets in doorways or in interior decorations.

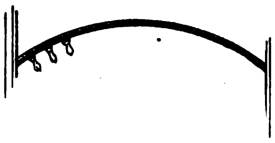


FIG. 4

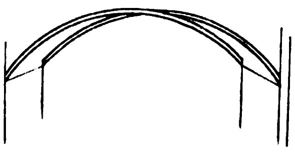


FIG 5

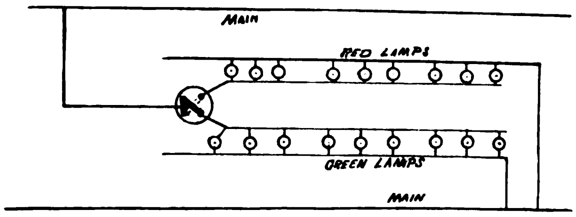


FIG. 6.

Color Variations.—Perhaps the liberal use of border lights or of lamps in fancy designs has already become somewhat commonplace in your city, or perhaps you have a special customer who wants something still more out of the ordinary. Then you can fall back on colored lamps. You can get them cheaply from the lamp dealers nowadays, and they are usually better colored than they would be if you had done the tinting yourself with aniline dyes. The colors of lamps used will depend on the store and the goods. You may want the patriotic "red, white and blue," or a green to set off a landscape scene, or a red to give a ruddy glow to a fireside. More than all that, you may want to have the colors varied, so as to change from one to another every half minute or minute. This idea of wiring for changeable colors has been carried out on a very elaborate scale in some of our larger cities, the Western Electric Company's tower of light in the "Electricity Building" at the World's Fair being a most notable example. In such cases the apparatus used is both complicated and expensive, but more modest and yet striking effects on the same plan can be produced at very little expense.

Take the simple case of a window where we want to have a red and a green tint shown alternately. Here the "wrinkle" which helps you out consists in wiring up the red lamps on one circuit and the green ones on another, with a three-point switch connecting them to the main (or feeder) wires. In Fig. 6 you have a diagram of the circuits for the purpose, the switch being turned so as to light the green lamps. On throwing the switch the contact bar will stand as shown by the dotted lines, thus disconnecting the green lamps and lighting up the row of red ones. Only a single switch is needed, and any boy with a little perseverance can stand or sit beside it to manipulate the colors.

If you want more than two colors, you can get a fine variety of combinations by using lamps of the three primary colors, red, yellow and blue, connecting each series to a separate switch. There are several makes of small-sized double-pole knife switches on the market (commonly called "baby knife switches") which are unequaled for this, as they show at a glance whether the current is on or off. The connections will be as in Fig. 7; and if you want to manipulate the colors from some hidden point, a simple "wrinkle" for keeping track of the colors displayed consists in arranging the switches as in Fig. 8. Then if but one switch is turned on, the color marked below it is the one shown in the window. When two switches are turned on at the same time, you get the color marked as connecting them. In this way you can show all the lamps burning together, or any one of these six tints—red, orange, yellow, green, blue and purple. Whoever manipulates the switches will get a good deal of satisfaction from such labeled switchboard, as he can then present the different tints at his pleasure and in any desired order, much to the surprise and gratification of the people on the sidewalk. Sometimes the effect is further enhanced by having the lamps themselves concealed from view, or by having them inclosed in opalescent (tissue-paper covered?) globes, which glow alternately in one color and then in another.

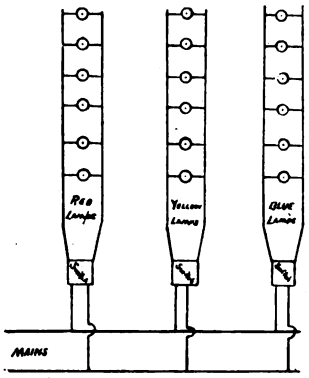


FIG. 7.

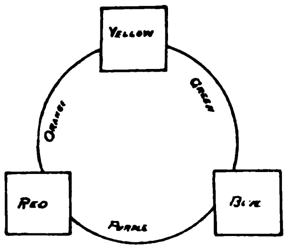


FIG. 8.

Electric Haulage in Coal Mines.

Electric locomotives are being installed in a very large part of the coal mines of Pennsylvania. The systems of electric haulage have been brought to as high a state of perfection as the surface electric railways. While the operation is similar, the conditions have necessarily required a change in the construction of apparatus and the invention of many new appliances. This method of haulage increases the output of the mines a large extent by facilitating the transfer of the coal to the surface. The work done by electric locomotives in coal mines is best shown by a comparison with the previous methods.

In the mines of O. S. Johnson, at Green Ridge, Pa., the electric locomotive does the work which would require thirteen mules and eleven drivers and runners, under the old methods. At the Ontario tunnel of the New York & Scranton Coal Co. in Peckville the work done by the electric mine locomotive would require nine mules and six boys. This company has also another locomotive at the Sturges. These systems were installed by the Scranton El. Cons. Co., which has just placed another electric locomotive in the Bellevue mines. These locomotives in many instances haul trains of mine cars around sharp curves and up steep inclines.

NEW APPLIANCES

[This department is devoted to the illustration and description of new electrical and mechanical appliances. They will be selected with a view to the interest and value that is possessed for the reader and not with the view to exploiting the apparatus of any maker. Cuts or drawings and descriptions of new devices or new applications of old appliances will be thankfully received for insertion.]

Card's Improved Fuse Box for Street Railways.

In street railway service the fuse box is a necessary part of each car equipment and should receive the careful attention of every street railway company. The success of any system depends largely on the completeness of minor parts and the readiness with which they perform their part of the work.

The accompanying cuts show Card's improved fuse box for street railways, manufactured by The Card Electric Company, Mansfield, O. Fig. 1 shows the slate box without metal case and is well adapted for use on cars when placed under the seat or in some other protected place. It is made with a slate bottom and sides and has brass binding blocks at each end for securing the connecting wires. At one end is a small spool, on which is wound a length of the fuse wire selected. The wire passes from the spool under a clamping piece on the binding block, through a slot in the slate partition and under another clamp on the opposite binding block, completing the circuit. Fig. 2 shows the slate box in a metal case, for use on the outside of cars. The lid closes tightly and the box has a projection along the top, making it water and snow proof. A folded piece of asbestos slips inside the box along the sides, over the fuse, insulating the lid. Fig. 3 shows the box with the front open, exposing the fuse. The spring on the outside of the lid acts to hold it either closed or open.

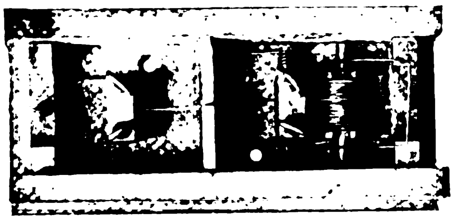


FIG. 1.—CARD'S IMPROVED FUSE BOX FOR STREET RAILWAYS.

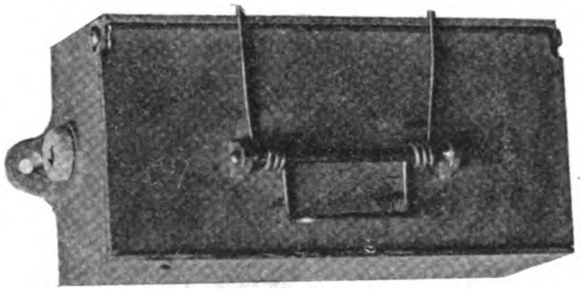


FIG. 2.—CARD'S IMPROVED FUSE BOX FOR STREET RAILWAYS.

When a fuse blows all that is necessary to do is to loosen the thumbscrews, pull through more wire and clamp it down. No hunting for wire never found and no time lost. Each spool will hold thirty-five feet of No. 21 cooper wire, enough for 100 fifty-ampere fuses. When the wire is used up the empty spool can be taken out and a full one put in without loss of time. As the proper size of wire to use depends largely on the grades, service and the motors, it should be determined by the superintendent and then adhered to. This method will save burn-outs, time and money. It is not safe to permit motormen or conductors to select their own fuse wire, since the temptation is great to put in a large one and save themselves the trouble of frequent renewals. The value of this improved fuse box can be better appreciated by street railway managers by ordering one from the Card company for trial. The price complete is very low.

Ironclad Generators and Stationary Motors.

The list of slow and moderate speed four pole dynamos and motors of the General Electric Company, has been supplemented by a series of machines adapted to smaller output than is practicable with the four pole type. They are classed under the head I. B. from the fact of having an ironclad bipolar frame, and are built for various outputs—from three-quarters to four and one-half kilowatts as generators and from 1 to 5 horse power as motors.

The frames are cylindrical and are supported on short legs. This brings the center of gravity very low and conduces to stability and steadiness when running. The space occupied by the machine is small for its output, and its shape and construction allows of its use in positions where machines of the ordinary bipolar type could not well be placed. The armature has a toothed core with the conductors embedded in the slots. Ample cross section has been allowed the copper in the field and armature windings, and the insulation is of the highest grade.

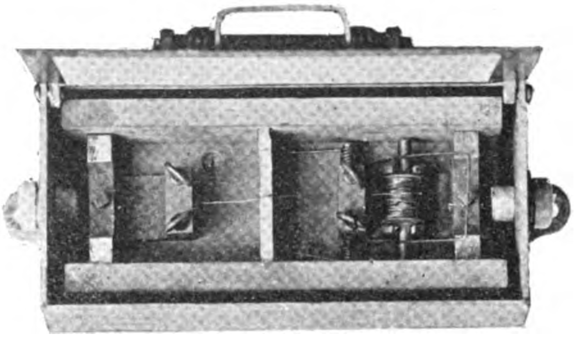
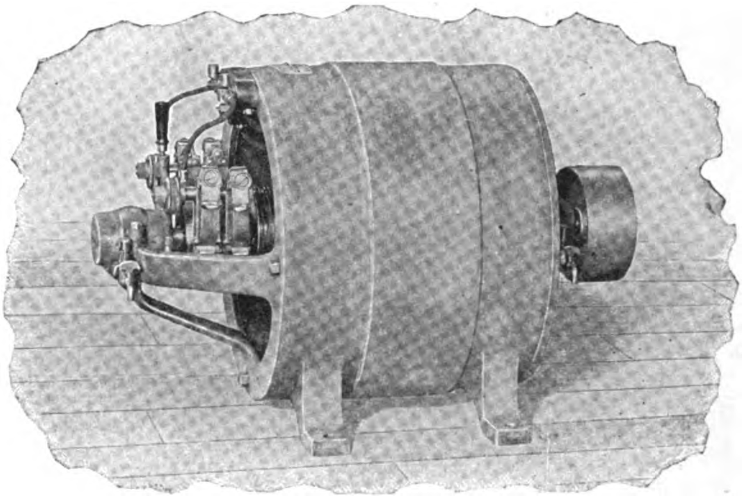


FIG. 3.—CARD'S IMPROVED FUSE BOX FOR STREET RAILWAYS.

The brush holders are designed to hold the brushes firmly and evenly upon the commutator, adjusting themselves readily to the wear of commutator and brush, preserving under all conditions a good contact without excessive friction. The speeds are comparatively low, varying from 1,800 to 1,000 revolutions per minute, according to the size of the machines. They are especially adapted to the requirements of small motor service. Their small size, low speed, high efficiency and simplicity of construction render them peculiarly valuable in printing, wood turning and establishments of a similar character, and for operation of small pumps, ventilating fans, machine tools, etc. A large number of these I. B. motors are already in use. The generators are successfully used in isolated plants and in cases where a small amount of current economically generated is desired.

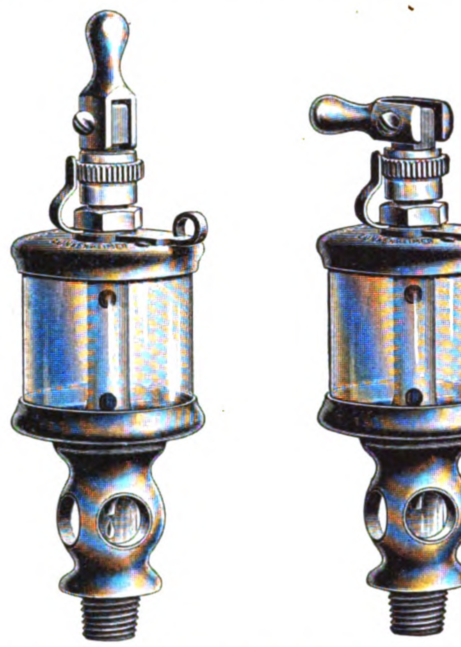


IRONCLAD GENERATORS AND STATIONARY MOTORS.

The Clark St. electric line of the Chicago City Railway Co., has been extended to Washington St.

The Sentinel Glass Oil Cup.

Oil cups of many kinds have been placed on the market from time to time, some of which possess features adapting them to use with modern machinery. The special features of the oil cup illustrated herewith will be at once noticed. The feed may be regulated to any amount by raising the lever and turning the milled thumb-nut until the desired feed is obtained. The feed can be stopped at any time by lowering the lever. When the lever is raised to an angle of 45 degrees it raises the feed stem from its seat and the cup flushes.



FIGS. 1 AND 2—THE SENTINEL CLASS OIL CUP.

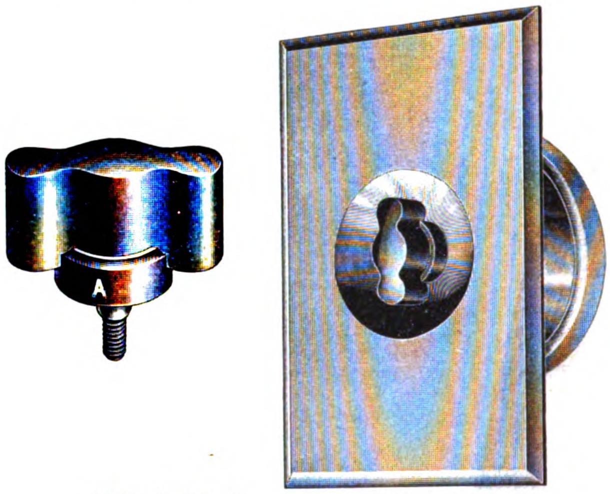
The feed of the cup can be watched through the glass sides. It is simple in construction and there is nothing about it that will get out of order. When placed on moving or jarring machinery will not shake it to pieces. The feed regulation will not be changed from the position to which it is adjusted when the lever is raised or lowered. The rate of feed will be continued until cup is empty unless the regulation is reset or the feed stopped by shutting off the feed. It is strongly constructed and well finished either in plain brass or nickel. Great care is taken in the manufacture of these cups by the manufacturers, the Lunkenheimer Company of Cincinnati, Ohio, and they are guaranteed to be first-class in every respect.

Hart Flush Switches.

The increasing demand for flush switches adapted to be set in a recess of the wall with the finished metal cover practically flush with the surface of the wall has led the Hart & Hegeman Manufacturing Company, of Hartford, Connecticut, manufacturers of the well-known "Hart Switches," to bring out an improvement in this line of goods. They were the first on the market, we believe, with a flush switch made by attaching the switch to a rough cast plate for holding the switch to the wall, the whole being covered and concealed by a finished thin sheet metal plate with flanged edges held in position by the switch handle which set in a recess in the face of this plate, thus avoiding any screw heads on the surface of the finished plate.

These finished plates being made of thin metal were very liable to become injured in use, and at the best were not perfectly flat, and in the right light many appeared wavy. The new plate illustrated in Fig. 2, is made of solid plate brass, $\frac{1}{8}$-inch thick, with edges milled to a bevel. The switch itself is attached to a brass ring D, Fig. 3, having ears B fastening it to the wall. When this ring with switch attached is screwed to the wall the ears project their thickness from the face of the wall and are accommodated by pockets C in the back of the face plate F, allowing this plate to set back against the wall. In all flush switches made on the old plan, there is always a variation in the distance from the plate to the porcelain base of the switch, and when the handle is screwed on it frequently binds on the plate, making it turn hard and oftentimes breaking the handle, or else it does not screw down far enough to hold the plate in position, and allows it to rattle when the switch is turned.

This difficulty is now obviated by the self-adjusting handle shown in Fig. 1. The collar A of this handle has a vertical movement with reference to the body of the handle of more than $\frac{1}{16}$-inch and is held downward by a flat spring which it encloses and conceals. This spring-pressed collar holds the plate firmly against the wall with an easy, elastic pressure. The shape of the handle is easy to the hand, and the large section of material around the metal interior gives it great strength. The material is stronger than that heretofore used. The range of movement of the collar A compensates for all variations liable to occur in the distance from the face of the plate to the porcelain base of the switch. This adjustment makes all handles, switches, and face plates interchangeable, with no danger of the handles binding on the face plates, either breaking the handles, or causing them to turn hard, or of the face plates being too loose. This adjustment is especially advantageous in gang plates. Single plates for all sizes of the Hart switches, and gang plates for any number of switches are now furnished, made as described above and with self-adjusting handles.



FIGS. 1 AND 2.—HART FLUSH SWITCHES.

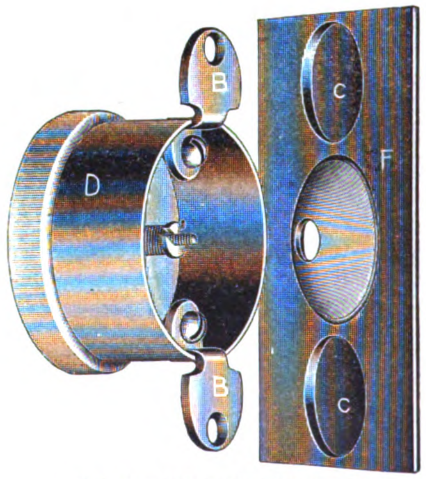


FIG. 3.—THE HART SWITCHES.

The dimensions of the different plates is given in Catalogue B. Special plates of any required size are made to order. Gang plates are frequently furnished with bell buttons or automatic gas lighting buttons set in the plate. Plates in any of the standard finishes are carried in stock and special finishes to match other hardware are furnished promptly.

Power is about to be furnished from the Niagara Falls Power Co.'s plant to the street railways of Niagara Falls and vicinity.

ELECTRICAL CATECHISM

[This catechism is designed to answer the numerous questions that continually come up in the minds of those who come in contact with the applications of electricity. The questions are gathered from a variety of sources and have been selected with a special view to bringing out such points as may be helpful to electrical workmen. *Copyrighted 1895.* ELECTRICAL INDUSTRIES PUB. CO. Commenced in Vol. VI, No. 2.]

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132. *What is the "field" of a dynamo?*

This word is used in three different senses: (A) It means the magnetism or the magnetic force in the space in which the wires move; in other words, the magnetic field in which the armature revolves. (B) The word sometimes refers to the iron through which the magnetic lines pass from one pole to the other. In many cases this also is the frame of the machine. (C) Sometimes men use the word, meaning the "field coil," the coil of wire which is placed around part of the iron frame, and which becomes the source of magnetic force when it carries current. The first is the correct use.

133. *What is the armature?*

The armature is the part of the machine in which the E.M.F. is produced, or in which the current is generated. As a general rule, the armature revolves and the field is stationary, but in a few alternators the armature is stationary and the magnetic field revolves.

134. *Of what parts is the armature composed?*

The armature wires or coils are the principal part. These are attached to the "armature core," which generally consists of a large number of discs of sheet-iron fastened together upon a spider or directly upon the shaft. Another part is the "commutator," to which the ends of the armature wires are attached and with which the "brushes" make contact to carry the current to the outside circuit.

135. *Why is the armature core made of thin sheets instead of being solid iron?*

Because the iron core revolves with the armature wires in the magnetic field, and an E.M.F. is induced in the iron as in the wires. This E.M.F. would cause currents in the iron which would absorb power, but which would not be useful. Such currents are called "eddy currents," or "Foucault currents," after their discoverer. By laminating the core—that is, by building it up of sheets—the paths of these currents are broken up and they are prevented.

136. *Why is an iron core used for supporting the armature wires? Would not wood or some other insulating material do as well?*

Iron is used because it offers a good path for the magnetic field. The entire magnetic circuit of the dynamo or motor is made of soft iron so far as possible, because iron makes an easier path than air. By having the armature core made of iron, the total amount of magnetism is greater and a much larger part of the total magnetism passes through the armature. All of the magnetism that does not pass through the armature is lost.

137. *What is meant by the "stray magnetic field" about a dynamo or motor?*

Hold a screwdriver or wrench near different parts of the iron frame of a dynamo or motor that is running, and it will be attracted more or less strongly at some positions. Wherever the iron is attracted, it indicates that some of the magnetism leaves the field magnet at that point. Some styles of machine have much stronger stray fields than others.

138. *What harm is there in a stray field about a machine?*

It is liable to magnetize watches so that they will not keep correct time; it is liable to attract tools or pieces of iron into the machine, with danger of getting against moving parts or making electrical connections where not wanted; the stray field may cause heating in the pulley. Cases have been known where dynamos magnetized the engine so that the governor would not act properly. Stray magnetism means that part of magnetic field is not useful in generating E.M.F. in the armature, and so means waste of energy in the field coils.

139. *How can magnetism be removed from a watch?*

One way is to place the watch in the center of a coil of wire through which an alternating current is passing. Then draw the watch away slowly while the coil is still carrying current. The magnetic parts of the watch thus have the magnetism rapidly reversed, each magnetization being weaker than the reverse one preceding.

Another way is to hold the watch on a twisted string and bring it near a pole-piece of a dynamo; then move it away while it is twisting rapidly.

140. *Is it possible to prevent watches from becoming magnetized?*

Common watches must be kept away from strong magnetic fields or they are liable to become magnetized. Some of the so-called "non-magnetic watches" have the springs and balance wheel made of some non-magnetizable substance, such as phosphor-bronze or other alloy. Some of these are not affected even by comparatively strong fields.

141. *Do the "magnetic shields" sometimes sold for watches keep out the magnetism?*

They may if made thick enough, but as generally made they are useless except to the seller. No substance has yet been discovered which will not allow magnetic lines to pass through it. Consequently the only way to prevent magnetism from getting in any space is to keep it away from magnetic fields. One way to do this is to provide an easier path for whatever stray magnetism may be about. The magnetic shields are intended to be made of some metal, such as soft iron or nickle, which is so good a conductor that any magnetic lines of force will pass around through the iron rather than through the space enclosed. A thick iron pocket or case is therefore the best anti-magnetic shield, but it must be thick to be of any value.

142. *Why do the Weston station ammeters and voltmeters have cast-iron cases?*

Partly to furnish so good a path for any stray magnetic field from the dyamos or bus-bars, that it will pass through the case and not enter the space inside where it would interfere with the correct working of the instrument.

143. *What is meant by ammeters or voltmeters being "iron-clad?"*

Some instruments have iron cases to make the instrument free from disturbances by outside magnetic fields.

144. *Are ordinary ammeters and voltmeters affected by the stray field about a dynamo or motor?*

Some excellent instruments may be affected so that the measurements are several per cent too high or too low if the instrument is within ten feet of an electric machine.

145. *How can one tell whether or not an instrument is affected by a stray field?*

By turning the instrument half way around, while it carries current, so that the stray magnetism will be relatively in the opposite direction. If it is affected by the field, the instrument will read higher in one position than in the other. The average of two readings, taken in opposite positions, is the correct reading.

146. *Can magnetic leakage from a dynamo or motor be prevented?*

Not entirely. After a machine is finished, it is practically impossible to reduce the magnetic leakage, although it may be made greater by placing iron near the poles. The stray field may sometimes be confined to the space near the dynamo by surrounding the machine by a thick iron case.

147. *Can magnetic leakage be reduced by proper design?*

By making the regular desired path through the armature of very low magnetic reluctance, a larger proportion of the lines from the field will pass through the armature and fewer will stray. The lines follow the easiest path. The armature core should contain plenty of soft iron, and the iron core should come as close to the pole-pieces as is possible while allowing sufficient mechanical clearance. Some machines, especially those with toothed armatures, require a wider air-space than others, in order to prevent excessive sparking at the brushes.

148. *What is a bipolar machine?*

A bipolar machine is one whose field magnet has only two poles, one being a "north" pole and the other, of course, a south pole.

149. *What is a multipolar machine?*

A multipolar (sometimes abbreviated to "M.P.") machine has some multiple of two poles. Multipolar machines frequently have four poles; although it is not uncommon to have six, eight, ten, or even more. Alternators rarely have less than ten poles. The 1,000 horse-power alternators at the World's Fair had thirty-six poles.

150. *Does a dynamo or motor always have an even number of poles?*

Yes. There are as many "north" poles as there are "south." Generally each alternate pole is north and those between them are south.

The Coventry Electric Tramways, Ltd.

The history of the tramways of Coventry, England, is most interesting. It is the history of tramways in general. Commencing with the stone tramway in 1811 it has followed the advancement until the electric road in its highest development has now been installed. This road runs from Coventry to Bedworth, a distance of six miles. Electric traction follows steam which was unsuccessful as far as dividends were concerned.

In the reconstruction of the line and the equipment of the road American practice has been followed. This is not to be wondered at since nowhere has the electric railway reached such perfection. The road is single track with numerous turn-outs. Two trolley wires are run the entire distance to avoid delay at switches. The track is an 84 pound grooved girder, laid on six inches of concrete and paved with granite. The gauge is three feet six inches. The rails are bonded with the Chicago rail bound.

The trolley wires are hard drawn copper, .32 of an inch in diameter. Several methods of suspension have been employed. Along Greyfriars Green the trolley wire is suspended by arms from ornamental posts which also support the street lamps. In the narrow streets the supporting cables are suspended from rosettes bolted to the front of the buildings. On another section where a double track is allowed, center poles are used. The trolley wires are divided into half mile sections connected through a switch placed in a box on a pole, to the feeders. The feeder cable is carried a part of the distance on the poles and a part underground.

The car equipment consists of ten motor cars which will carry 40 passengers each, twenty inside and twenty out. The trucks are Peckham cantilever, and are equipped with No. 12, Westinghouse, 25 horse-power motors. The motors are suspended in the manner adopted by the Westinghouse company. Westinghouse series parallel controllers are used. The trolley arms are insulated and so placed as to be out of reach of passengers on the upper deck.

The power house is well equipped with the latest machinery for the economic generation of power. The boilers are of the Babcock & Wilcox type and are equipped with mechanical stokers. Worthington pumps supply water either from an adjoining canal or a well on the premises. The engine and dynamo room contains two 120 horse power engines built by Browett, Lindley & Co. Each engine is belted to a 100 kilowatt Westinghouse multipolar railway generator. Current is generated at 500 volts. The switchboard is of the regular Westinghouse panel railway type and makes an imposing appearance with its white marble face and polished brass trimmings.

The engine also contains a small lighting generator operated by a Sturdevant engine which supplies the station with lights. The automatic stoker is also operated by a Sturdevant engine. The engine is used at times to operate such machine tools as the repair department uses.

By an accident at the electric light station at Northampton, Mass., L. J. Hutchinson, superintendent, was almost instantly killed. His clothing caught in the shaft and he was dashed to the floor.

CORRESPONDENCE

[Communications from practical men will be gratefully received for publication in this department on all subjects pertaining to electricity. If you have an idea, a question, or an item about the operation of your plant you think will interest others please send it in for publication without delay, and in this way the value of this column to everyone will be greatly increased. Drawings to illustrate a point are always appreciated. We hope every reader will feel a personal interest in this department.—Ed.]

EDITOR ELECTRICAL INDUSTRIES: Dear Sir.—In your October issue you give a record of a boiler and engine test which is very misleading. It says: "Pounds coal per day 10288.3" and horse-power per day 778.85," and "pounds coal per horse-power 1.321." Now as near as I can figure 10288.3 divided by 778.85 gives 13.21 pounds coal per horse-power instead of 1.321 which makes quite a difference. I think "the long experience which is known to be accurate" had better be looked to before any more tests are published, if you wish practical men to use your paper.

Yours respectfully,
WARNER W. MCKEE,
Chief Engineer, Worcester, Conn., St. Ry. Co.
Worcester, Mass.

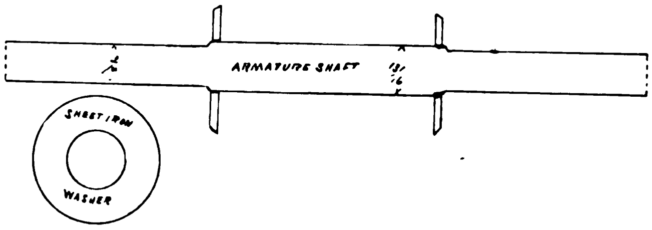
The tests referred to were published on page 274 of the October number of ELECTRICAL INDUSTRIES. The results as published are correct and the confusion arises from the fact that the horse-power is stated as 778.85 per day, which should have been hour. The "coal per day" divided by ten to find the average per hour, gives the result as stated. The more complete statement is as follows:

Pounds of coal per day	10288.3
Pounds of coal per hour	1028.83
Horse-power per hour	778.85
Pounds of coal per horse-power hour	1.321

In the figures as printed of the boiler tests there is, however, an error in the omission of a decimal point. The amount of coal is given as 63731 pounds for 60 hours and directly under it the pounds per hour is given as 10622. The decimal point being omitted (1062.2) the result appears ten times too much. This error would be quickly noticed by following the computations. For fear that some greater error might have been made the printed copy was forwarded to be compared with the original report and with the above correction agrees.—[Ed.

INSULATING ARMATURE CORE.

ELECTRICAL INDUSTRIES:—In constructing an armature of sheet iron washers, I beg to ask, if I would have to wrap the armature shaft with manilla paper and if so, why? I have been told by one person it was necessary and by another that it was not, and am unable to determine which is correct. The enclosed sketch will illustrate the construction of the armature I intend building. Respectfully,



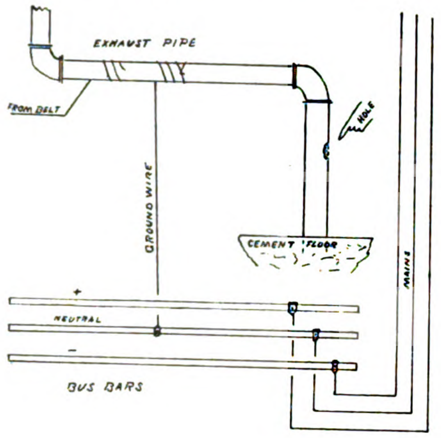
FRED WUENCH.

St. Louis, Nov. 17.

[It is not necessary to insulate the core plates from the shaft, but the plates should in some way be insulated from each other. It is important that the core be covered with an insulation covering, and also a covering that will protect the insulation of the wires from a mechanical injury when wound on or when handled after armature is completed. The corners should be especially well covered.] Ed.

DESTRUCTION OF STEAM PIPE.

Electrical Industries: The accompanying drawing illustrates the point of an argument I have had with several parties. The exhaust pipe A is from the engine and passes down into the cement floor. The bus bars of the Edison three-wire system are shown and also the mains which pass within about twelve inches of the steam pipe. Our dynamos are on first floor and engines in the basement. The mains go down into the basement and through engine room to underground system. The neutral wire is grounded to the steam pipe and there is also a ground wire for the static electricity of the belts connected to the steam pipe near the same point. About two feet above the cement floor the exhaust pipe has been eaten into. The space near the pipe is very damp. Does the static electricity have anything to do with the making of this hole? Several think the static electricity did the mischief. I would like to hear what your readers think about it.

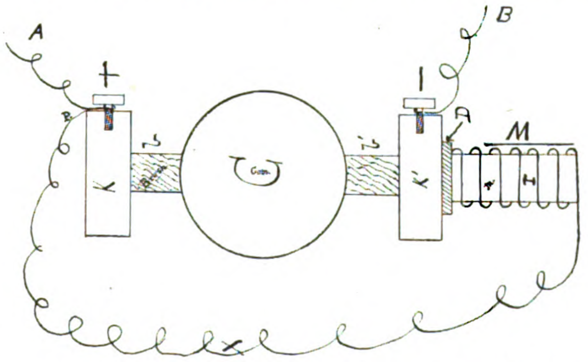


Wm. F. Frank.

Minneapolis, Minn.

PREVENTING COMMUTATOR SPARKING.

Electrical Industries.—Being an interested reader of your journal, and not having the requisite apparatus convenient, I would submit for your consideration, or that of your readers, the proposition as outlined in drawing, and would like an opinion as to its practicability as applied to dynamos in general; whether such a device would eliminate the destructive sparking between the commutator and brush, or whether in your opinion the end aimed at is unattainable. In the diagram A and B are the leads from the machine; K K¹, the brush holders; b b¹. are the brushes, C the commutator and X is a shunt from the positive to negative brush which forms the winding of the magnet coil as indicated. D is the insulation separating the soft iron core of the magnet from the brush holder, the object being to absorb the current at the break of contact between commutator segment and brush and thus prevent the arcing. Respectfully,



"W. S."

Philadelphia, Pa.

ELECTRIC LIGHT FOR STEREOPTICAN.

The dissolving views as produced by the calcium light in the stereopticon are very pleasing and desirable. It however, seems impossible to produce the same smooth effect with the arc light yet in many places the electric light would be much more convenient and economical. If there is anyone who has successfully accomplished the problem of displacing gas with electric light in the use of the stereopticon with the dissolving views I have several customers for him. Yours truly,

Chicago. Thos. G. Grier.

WHEN THE TROLLEY JUMPS OFF.

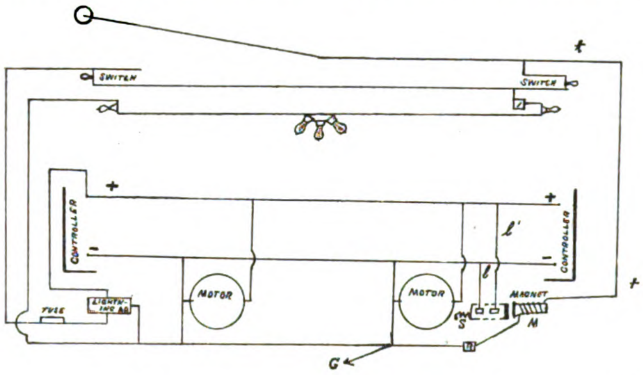
Editor Electrical Industries:

Dear Sir:—While the entire practicability of the apparatus outlined below, may not be evident from an economic standpoint, yet the suggestion may prove of interest to your readers as a possibility.

The idea occurred to me that if the consequent breakage and loss of time (caused by the trolley pole leaving the wire, while a trolley car is in rapid motion) could be avoided by some simple and efficient automatic method, without the use of any great amount of current, that such a device as shown in the diagram might prove a step in that direction.

It quite frequently happens, as I have often noticed on our city lines, that the conductor is busy inside the car when the pole flies off, and by the time he manages to grab the rope, the car is under a span or bracket arm as the case may be; and the chances are that the span breaks or the trolley pole bends, as a weak spot is developed in either. So that the advantages of such an arrangement as I suggest would be manifest.

In making the sketch I have not attempted to give the exact connections of motors and controllers, as it would mean a complicated, mechanical drawing not easily understood.



The operation of the device depends upon the magnet M which is supplied with current by tap *t* connected to the trolley at trolley base, so that it will receive current as long as the pole remains on the wire. R is a high resistance in series with the magnet, so that the current used is reduced to as small a quantity as is consistent with the correct action of the magnet. Let us say that it be 5,000 ohms, then with current at 500 volts only 1-10 ampere would be required; to compensate for low amperage, turns can be piled on, to bring magnet to desired excitation, the small current allowing the use of a fine wire of many turns.

The spring S to be so adjusted that it will pull the sliding contact and short circuit, the leads *l l*¹, when the armature is released by the magnet, as the current ceases to flow through its coils.

The action of the magnet is as follows: When it does not receive current, by reason of source of supply giving out, it releases its armature, thus closing the circuit of the motor or motors through leads l l¹, causing them to generate and bring the car rapidly to a stand. The instant the current flows again, the armature is attracted and moves up toward the magnet, breaking the motor circuit (the spring which closes the leads l l¹ to be made somewhat weaker than the tractive force of the magnet, so that under normal conditions the action will be positive).

The connections might be so made as to use either one motor or both to generate, whichever proved most desirable. The extra apparatus required for a car equipment, could be placed in a small box underneath the car, and with a fuse in the circuit, would occupy but little space.

Yours sincerely,

Philadelphia, Pa. W. Sonnberg.

NEW BOOKS.

An Experimental Study of Field Methods, Which Will Insure to Stadia Movements Greatly Increased Accuracy. By L. B. Smith. Bulletin of the University of Wisconsin, 1895, Madison, Wis. Price, paper 35 cents.

Railway signalling. By W. McC. Grafton, signal engineer, Pennylvania lines, west of Pittsburg. Bulletin of the University of Wisconsin, 1895, Madison, Wis. Paper, price 35 cents.

The author gives a brief history of railroad signalling, then takes up interlocking signals, discribing the general plan, the arrangement and construction of the several parts. The lecture has been carefully prepared and is accompanied by drawings illustrating the various parts of the systems described. It is interesting both to those connected with this branch of engineering and to the general public.

Instruction Book for the Maintenance and Handling of the Hunt Air Brake System. The Hunt Air Brake Co., 1895, Pittsburg. 56 pages, Diagram and Charts, flexible cloth, note book style.

An analysis and description of the Hunt Air brake and system for electric and cable cars designed especially for those intrusted with the care and operation of the brake. It is written in a clear and concise manner readily understood by any one with a knowledge of English. The text is fully illustrated by cuts and diagrams which show the construction and manner of operating the brake. It is bound in a style adapted for the pocket, serviceable and easily handled. A novel chart illustrating the operation of the three way value accompanies the book and is found in the pocket on the inside of cover.

Poor's Directory of Railway Officials. Tenth annual edition. 1895. New York. H. V. & H. W. Poor, 44 Broad St., New York. Cloth, price $3.00.

Many new features have been introduced in this volume, which has been carefully revised to October 25, 1895. Tables of dividends paid by the large and important corporations of the country during the last eight and one-half years, table showing place and date of their annual meetings, the registrars of stock, etc., are some of the new features of this volume, which now contains over 700 pages. The directory of street railways is a most important one for investors, bankers, etc. The directory of railway officials, which forms the bulk of the contents, is of great value both to investors, bankers, railway officials and to the manufacturers and dealers in railway material and supplies. The arrangement of the information has in many ways been improved. the introduction of the tables has increased the facility with which information may be obtained, and comparisons made between the different corporations.

The Practical Engineer Pocket Book and Diary for 1896. Edited by W. H. Fowler, Technical Publishing Co. Ltd., Manchester, Eng. Flexible leather, pocket size, 400 pages, price postpaid anywhere, 1s. 6d. net. (38 cents).

The yearly editions of this pocket book, which are annually revised and brought up to date, furnish a most convenient reference book and diary for a large class of engineers. To the mechanical engineer it is found of constant assistance; to the electrical engineer whose work is often closely associated with that of the mechanical engineer is also helpful and the information contained therein should be of assistance to steam users in general. This edition has been revised, several sections added and others enlarged. Among the additions are some fifty pages of electrical notes complied by S. T. Harrison of University College, Cardiff. These notes include definitions, tables and general information respecting electrical appliances and installations. The different systems of wiring, the methods of making joints in conductors, etc., are explained. The book is worth many times its cost.

PERSONAL.

Mr. W. A. Foote, manager of the Jackson, Albion and Battle Creek electric lighting plants, was in Chicago on a business trip last month.

Mr. Francis R. Upton, of the lamp department of the G. E. Company, has severed his connection with that company and accepted a position with the National Tube Works of McKeesport, Pa., in which his many friends wish him success.

Mr. Chas. E. Gregory, since recovering from his recent illness, has increased his averdupois fifteen pounds. Having sold a controlling interest in the company to Mr. A. L. Kuehmsted, Mr. Gregory will not again take an active part in the business.

Mr. W. S. Lawrence, of the Mountain Electric Co., Denver was a recent visitor to Chicago.

ELECTRIC LIGHT, RAIL'Y AND POWER

EXTENSIONS AND IMPROVEMENTS.

Hudson, Wis.—Burkhardt & Andrews expect to install several more motors in the near future.

Lead S. D.—Bult Light & Power Co. will soon add a 3,000 light alternator to its present equipment.

Shamokin, Pa.—Shamokin El. Lt. & Power Co. last month installed an 800 light Wood incandescent.

Murfreesboro, Tenn.—The Ft. Wayne Electric Co. is putting up a large number of new street arc lights.

Nazareth, Pa.—Nazareth Elec. Lt. & Power Co. contemplates lighting the borough with arc lights.

Slatington, Pa.—The Citizens Electric Light Heat & Power Co. will put in a new incandescent dynamo.

Janesville, Wis.—Janesville Elec. Lt. Co. is adding to its power plant 175 horse-power engine capacity.

Martinsburg, W. Va.—Edison Electric Illg. Co. will soon add a new alternator to its present equipment.

Wellston, Ohio.—Wellston & Jackson Belt Ry. Co. will extend its lines from Wellston to McArthur Junction.

Ennis, Texas.—Ice Light & Water Co. will remodel plant and add engine and dynamos to present equipment.

San Angelo, Texas.—San Angelo Light, Power & Irrigation Co. is in the market for a new 80 horse-power boiler.

Franklin, Tenn.—Harpeth Electric Light & Power Co. will overhaul its lines and increase its commercial lighting.

Chicago, Ill.—The Chicago City Railway Co. is relaying a large amount of track for both electric and cable lines.

Tyler, Texas —Tyler Electric Light & Power Co. is putting in a new boiler to give the boiler capacity now required.

Pen Argyl, Pa.—The Pen Argyl Electric Lt. & Power Co. will add to its incandescent equipment in the near future.

Langhorne, Bucks Co., Pa.—Langhorne Elec. Lt. & Pr. Co. will add a generator for supplying power for a trolley road.

Westerly, R. I.—The Westerly Gas & Electric Light Co. has recently installed a thousand light G. E. incandescent dynamo.

Hamburg, Pa.—Hamburg Electric Light, Heat & Pr. Co. expect to put in a new switchboard, an exciter and the necessary fittings.

Sherman, Texas.—The city intends adding a large number of street lights. The city has now 43 arc operated from an arc machine.

Alma, Wis.—G. A. Kurtz, owner of lighting plant, is in the market for a continuous fence machine and a saw mill for sawing pickets.

Madison, S. D.—Madison Electric Light, Heat & Power Co. would exchange its present 150 horse-power Allis Corliss for a smaller engine.

White Plains, N. Y.—New York, Elmsford & White Plains Railway Co. contemplates extensions amounting to about 15 miles of track.

Ft. Wayne, Ind.—Ironton & Petersburg St. Ry. Co. expects to equip its lines for electric power soon. J. R. Cook, of Ironton, Ohio, is manager.

Spartanburg, S. C.—The Aetna Light & Power Co. is building ten miles of electric railway and contemplate the erection of a new power house.

Kennett, Pa.—Kennett Electric Lt., Ht. & Power Co. contemplates the installation of 500 horse-power two-phase alternator for power service.

Freeland, Pa.—The Freeland Electric Light, Heat & Power Co. will in the near future extend its lines and add to the equipment of its power station.

Shippensburg, Pa.—The Shippensburg Electric Lt. Ht. & Pr. Co. has just put in a new arc dynamo and will soon install an additional incandescent dynamo.

Morton, Pa.—Faraday Heat, Power & Light Co. is in the market for a new boiler and is about to build three miles of new lines for the lighting system.

Allegheny, Pa.—The city lighting plant has recently been enlarged by the addition of 500 arc light capacity. D. Hunter, Jr., is superintendent of the plant.

Chicago, Ill.—The Calumet Electric Street Railway Co. has secured a number of new franchises and will commence the construction work as soon as the grants are confirmed by the mayor.

Canton, S. D.—Canton General Electric Co. would like to correspond with parties who would invest in central station property, as opportunity is offered to greatly increase present business of the company.

La Crosse, Wis.—La Crosse Brush Electric Light & Power Co. has recently been awarded a contract for lighting the streets of La Crosse. Contract calls for 200 arc lamps of 2,000 candle power.

TAMAQUA, PA.—The Edison Electric Illg. Co. has just completed the installation of an arc lighting system and will begin operating it the first of this month.

DAYTON, TENN.—Dayton Electric Lt. Plant. S Nelson, lessee and manager, expects soon to add a boiler, engine and about 20 arc lamps to its present equipment.

MT. VERNON, OHIO.—The Mt. Vernon & Walbonding Electric Railway Co. expects to build 22 miles of road the coming year. Road will be operated by water power.

CLEVELAND, TENN.—Cleveland Water & Electric Lt. Co. is putting in an incandescent system for lighting. The company has previously operated arc lamps exclusively.

RUTLAND, VT.—The Marble City Electric Co. has recently added a Westinghouse alternator and a Western Electric arc dynamo and a corresponding lot of appliances.

CINCINNATI, OHIO.—Pendleton, Mt. Lookout & East Walnut Hills Ry. Co. will operate its lines with electricity during the next year and extend its lines about three miles.

MCKINNEY, TEXAS.—McKinney Electric Light Co. expects to increase its power plant. It is using the alternating current system and has 1,600 incandescents now connected.

WESTON, W. VA.—The Weston Electric Light, Power and Water Co. expects to purchase soon a 200 horse-power engine and next spring will put in considerable large feeders.

RIVER FOREST, ILL.—The village has recently contracted for seventeen additional 32 candle power incandescent street lights, which are to be furnished by the Maywood & Proviso Electric Light & Power Co.

BARTON, VT.—Municipal Light and Power Plant, H. T. Seaver, trustee, will turn on its lights for the first time the first of this month. There are nearly 2,000 lights wired for and both light and power will be furnished to citizens.

TRADE PUBLICATIONS.

A catalogue and price list of insulated wires and cables was recently received from the Bishop Gutta-Percha Co., of New York. The little pamphlet is brimful of information.

A new catalogue of electrical supplies has recently been received from C. M. Turnquist, 216 So. Clark St., Chicago. The specialties largely dealt in are illustrated and listed with net prices. This catalogue is mailed free on application to anyone interested in electrical supplies. An extensive mail business is carried on and supplies are shipped to all parts of the country.

W. D. Forbis & Co., engineers and manufactures, No. 1300 Hudson St., Hoboken, N. J., recently issued a catalogue setting forth the range of work undertaken and the character of engineer's service rendered. It is bound in dark paper with name and address embossed in red, making it conspicuous and attractive. The contents of the pamphlet sets forth concisely information regarding the work done and facilities for prompt execution. Some of the standard lines of machines built are described and illustrated, and tables constantly used by machinists are given. It contains twenty pages, six by nine inches.

Tobin Bronze is the subject of a pamphlet, recently issued by the Ansonia Brass & Copper Co., 19-21 Cliff St., New York. This metal has proved itself particularly adapted for a great variety of purposes. Its tensile strength is one of its great features, whether in wires, plates or forgings. Its resistance to corroding influences has led to its use in large quantities by the government and at the great ship yards. It is welded easily by the Thomson electric process. It is being used on many street railway systems for commutator segments which are drop-forged. This pamphlet explains the many uses of the metal and gives considerable information regarding methods of working. Tests and statistics will also be found in the latter part.

"It's a beauty," is the universal verdict regarding the new catalogue of the Raymond improved gas engine, just issued by the J. I. Case Threshing Machine Co., of Racine, Wis. The cover is of a delicate tint embossed in gold, and the contents are in keeping with it. This engine has been found most successful in the operation of electrical machinery, and to anyone acquainted with the conditions it will be apparent that if it will run such machinery successfully it will run anything. Some very good cuts of the engine are shown and also a number of illustrations of the works where they are manufactured. The pamphlet contains a very full description of the engine and lots of information regarding gas and oil engines. It is handsomely gotten up and a credit to all concerned.

The new illustrative and descriptive catalogue of the automatic cut-off engines built by the Ball Engine Co., of Erie, Pa. is an excellent production. It is clean and neat in every particular and treats of the horizontal and vertical, belted and direct connected, simple, tandem compound and cross-compound engines in a concise and comprehensive manner. The illustrations are very clear, showing every detail of the different styles of engines These engines have attained a high reputation for the operation of electrical machinery and this catalogue will, therefore, be of particular interest to those connected with such installations or contemplating the erection of a new station or remodeling an old one A number of views of direct connected engines and dynamos are given. Heavy duty engines designed for the hard service of electric railways are described with the general lines of engines The various important features of the several types of engines are pointed out in the text accompanying illustrations. The catalogue is bound in flexible covers, which give a good finish to the book.

Recent publications of the Siemens & Halske Electric Co. of America include "Electric Motors," "Band Arc Lamps" and "Electric Rock Drills." Each of these pamphlets are published in the size and style uniformly adopted by the company which makes them very convenient for filing and reference. "Electric Motors" is a pamphlet of twenty-five large pages describing the great variety of motors built and illustrating their uses. Motors are used for a wonderful variety of purposes and this pamphlet gives a considerable amount of information regarding the motors, the method of connecting to machines and appliances with which they are used The construction and operation of the band arc lamp is described in the second pamphlet issued in November. Also the different styles and sizes in which the lamps are constructed. In the third pamphlet Mr. W. Meisner describes the rock drills manufactured by Siemens & Halske Company and their use in connection with many industries. In the quarrying of stone, the mining of salt and minerals these rock drills are successfully used. The article also enters into the efficiency of the motors and tools and the capacities of the machines. The article is illustrated by photo engravings showing the use of the drills.

The Metropolitan's Mammoth Catalogue.

Red, white and blue, the national colors, adorn the cover of the mammoth catalogue just issued by the Metropolitan Electric Company, Chicago, W. H. McKinlock, president; W. C. McKinlock, secretary. The colors indicate undoubtedly the national character of the above company whose trade has gradually been extended until it covers every part of this great country. Located at the great central city with lines of communication unrivaled for reaching every part of the continent its facilities are the best conceivable for carrying on trade. This catalogue is unquestionably the largest catalogue ever issued of electrical supplies, containing nearly eight hundred large pages, crowded with matter. It makes a volume eight and one half by eleven by two inches thick. Within its covers will be found listed nearly every electrical supply and appliance now used in the extensive electrical installations which are continually multiplying. Its compilation has required an immense amount of labor and this issue has cost a small fortune. As completed it is a credit to the company and should be a matter of pride to those engaged in its production. The arrangement of contents is excellent, the system of code words well adapted for general use, and the index has been carefully made. To attempt to enumerate even a small proportion of the special lines of goods listed in this volume would cover too much space for this column. The contents are best measured by the word "everything." The value of such a work to every user of electrical supplies as well as to the company cannot be over estimated. To the user of electrical supplies it is an encyclopædia for reference on anything in the line of electrical goods. For the company it is an ever present salesman. It presents to the operators of electrical installations the latest improved devices on the market, the methods of construction, for the insulation and protection of electrical circuits. The volume is well printed, substantialy bound and cannot fail to be greatly prized by every one that shall receive a copy.

BUSINESS NOTES.

The Clark St., electric line of the Chicago Railway Co., has been extended to Washington St.

ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has the contract for for a lighting plant for the Endrick Woolen Mills at Great Barrington, Mass.

THE BRADFORD BELTING CO., Chicago, Ill., will issue their new catalogue of electrical supplies this month. The catalogue, it is said, will contain many new and novel devices. It will be mailed on application.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia, Pa., has removed its Chicago office from Dearborn St. to the fifteenth floor of the Marquette Bldg. Mr. C. W. Woodward, the manager of this office, reports a very good line of new business.

THE GOULD COMPANY, Chicago, recently closed a contract with the City of Austin, Texas, for two triplex pumps with a capacity of 3,000,000 gallons every twenty-four hours. These are said to be the largest triplex power pumps ever built in this country.

THE TRIUMPH ELECTRIC CO., through its Chicago agents, Messrs. Whiteside & Foster, Medinah Temple, report a large number of sales during the past few weeks. Among this number of sales are the following: Two 70 K. W. generators to the Stewart & Ralph Syndicate, of Philadelphia, to generate current for the Owosso & Corunna Traction Co's. new railway at Owasso, Mich.; a 9 K. W. machine to S. D. Kimbark, Chicago; 35 K. W. multipolar machine to Henry C. Durand, Chicago; 20 K. W.

generator H. M. Hooker & Co., Chicago; 20 K. W. machin. Nordburg Mfg. Co., Milwaukee, Wis.; 8 K W., Giddings & Lewis Mfg. Co., Fond du Lac, Wis.; 15 K. W. Bowan Mfg. Co., Fond du Lac, Wis.; 20 K. W., B. F. & H. L. Sweet Co., Fond du Lac, Wis.

Dixon's Silica Graphite Paint manufactured by the Joseph Dixon Crucible Co., of Jersey City, N. J., will be used in painting all the tin work and skylights of the postoffice department building at Washington. A quantity will also be used on the capitol and the district government building.

Osgood & Barker, Bellows Falls, Vt., the manufacturers of paper and pulp machinery, have commenced the manufacture of dynamos and motors. Special attention is given to the building of motors for boats and carriages. An order for a two horse power motor to take the place of engine on launch and a 200-light dynamo for a factory have been received.

The Hayes, Fyfe Co., Chicago, was succeeded last month by the Hayes, Tracy, Fyfe Co. and duly incorporated. The new company secures the services of Mr. Tracy and has increased its facilities for carrying on the manufacture of its automatic rheostats which have been well received by the trade. The company has removed its offices to 308 and 309 Pontiac Bldg., where it will also do its manufacturing.

Heubel & Manger, 286 Graham St., Brooklyn, N. Y., have found it necessary to secure additional factory space to enable them to take care of the greatly increased business. They have now nearly double their former floor area and are full of orders for their well-known and standard bells and pushes. A little folder recently issued calls attention to a number of novelties in this line, including bells, push buttons and switches.

The Van Auken Steam Specialty Co., Chicago, C. P. Monash, manager, recently sent out to the trade a folder, containing a suggestion as to the advisability of sticking to the high grade steam specialties of the Van Auken company. Some of these important specialties are mentioned, and the court plaster the folder contains will be found useful when you cut or bruise your hand. A calendar for 1896 will be found on the back page. It is sent free to any one asking for it.

Wm. Baragwanath & Son, the well-known manufacturer of feedwater heaters, purifiers, boiler, feed pumps, etc., had a fire in their shops the 6th of last month and were compelled to shut down the extensive works for a few days. The loss was slight, the main injury being to the belts, which were burned up, as well as a hole burned in the floor. The shops are, however, now running as usual, a large number of good orders having recently been received.

The Metropolitan Electric Company, 186-188 Fifth Ave., Chicago, reports trade unusually brisk in railway supplies. The new catalogue reviewed in this number has greatly increased the work of the office force, but by extra efforts the regular line of work has not been neglected. A number of new specialties have been added to the list of goods carried, and indications point to a heavy demand for supplies as soon as inventories are over. The buying of small lots until after statements are made up for the year is usual at this time and larger orders are looked for the first of the year.

Mr. C. D. Crandall, manager of the Western Electric Company, Chicago, has just returned from a trip to the western coast, having visited the cities of Portland, San Francisco, Vancouver, etc., spending some two weeks in the latter place. While there Mr. Crandall organized the Western Electric Light, Heat & Power Co., under the laws of British Columbia. This new company will put in an electric lighting plant, having secured a 50 years' franchise and a contract for lighting the city for ten years. Mr. Crandall expressed himself as being highly pleased with the country but thinks that it should be on this side of the Canadian line.

Chas. A. Schieren & Co. report among recent orders one from Hudson Electric Light Co., Hoboken, N. J., for two 48 inch three-ply electric leather belts; from the Jersey City Electric Light Co., Jersey City, one 48-inch double leather belt; from the L. C. Porter Milling Co., of Winoua, Minn., one 40-inch three-ply leather belt, and two orders aggregating 4,100 feet of belting for the island of Cuba. The firm is now tanning all its leather by pure oak bark, by a slow process used exclusively in the manufacture of leather for belting. Chas. A. Schieren & Co. are also to be congratulated on their belting receiving a silver medal at the Atlanta exposition, it being the highest awrad.

The Electric Appliance Company, 242 Madison St., Chicago, is now enjoying the benefits that its enlarged quarters afford. The business can be handled more expeditiously. The lamp trade has been especially good, and many flattering testimonials have been received for the Packard lamp. The Packard Mogul is growing in favor for lighting large interiors. In many places it is being used in preference to the arc lamp since it needs no trimming. "O. K." and Paranite wires are carried in larger quantities than ever before to allow all orders to be shipped from Chicago stock. The Upton arc lamp finds a customer each time it goes out as a sample. The "anti-hum" device makes it noiseless and a most satisfactory lamp for any place where arc lamps can be used. Its popularity constantly increases.

The C. E Woods Company, Monadnock Block, Chicago, has recently designed with their equipments a complete line of electric road wagons, including both business and pleasure wagons of several kinds. Vehicles of this kind are frequently seen on the streets of our large cities, and the demand for them has grown with improvements that have adapted them to hard service. The recent road race at Chicago and the races which have taken place and about to take place in Europe have given considerable impetus to the subject. The motors in this line of carriages are in most cases concealed together with the storage batteries carried. The electric vehicle has some advantages not possessed by any other type of motocycle and at the same time lacks many possessed by the gas engine carriages. These designs are the first adapted to the different kinds of road vehicles.

The General Electric Company is making a change of considerable interest to the shoe manufacturing trade for a factory in Ohio, and is now engaged in equipping its works throughout with electricity for the operation of its machinery. For this purpose a 75 horse-power M.P. moderate speed generator driven by a belt from a steam engine has been installed and a further provision made for a generator of about 100 horsepower for direct connection to an automatic engine. The current from the generators is supplied to the following motors. Two 3 horse-power capacity slow speed type, geared direct to the shaft of the fitting room; one of 15 horse-power belted directly to the line shaft in the bottoming department; one of 20 horse-power coupled directly to the dust collector; a further installation of motors will be made a little later on in the fitting room, and also in the bottoming department. Still another motor will run an additional dust collector, and two belted motors will run elevators. The first motors were started a few days ago and the operation of the machinery so far seems perfect. This is the first step towards the adoption of electricity in shoe manufacturies in that section, and it is anticipated that the economy and convenience shown in this plant will lead to its more extensive use in the operation of many old and certainly all new shoe factories.

The Triumph Electric Company, Cincinnati, Ohio, has recently purchased the entire plant of the Waddell-Entz Company, of Bridgeport, Conn., including all patents. This plant is being moved to Cincinnati, and will give the company one of the largest and best equipped plants for the manufacture of electrical machinery in the west. The Waddell-Entz machines were favorably known and acknowledged as high grade machines. The same excellence of design and construction will be adhered to, and such improvements as experience suggests will be embodied in these machines as manufactured by the Triumph company. This company has maintained a reputation for high grade work which is a guarantee that nothing but what has passed the rigid tests at the factory will leave their hands. It will be good news to the users of this type of machines, and many who have admired them, that it is again on the market. Information on the subject may be obtained by addressing the home office, or the nearest local office of the above company. It is not the intention to discontinue any of the present Triumph patterns, but to add to the variety of the output of these extensive works. The sales of the Triumph dynamos has increased greatly during the past season. The Chicago office has handled a constant stream of orders, and during the past week closed a contract with Armour & Co. for two 25-kilowatt dynamos.

WANT COLUMN.

In order to accommodate the patrons of this journal advertisements of "Help Wanted" and "Position Wanted", "Wanted to Buy", etc. will be inserted in this column at the very low rate of 2c. a word, no such advertisements to be inserted less than 12 words. Letters may be sent in care of ELECTRICAL INDUSTRIES if the advertiser does not wish name to appear in advertisement. Let your wants be known.

WANTED—Young man wishes situation in an electric light plant. Has had experience with dynamos and engines and is at present engineer of a large plant. Address Engineer, care Electrical Industries, Chicago.

WANTED—Position as superintendent of a central station by a mechanical and electrical engineer with eight years' experience, and a thorough commercial knowledge of the business. Address Competent, care Electrical Industries, Chicago.

WANTED—Position wanted as superintendent by a practical and experienced central station man, having been in charge and understanding the different departments and leading systems of lighting; also the economical management of steam plants. First-class recommendations from responsible lighting companies. Address Superintendent, care Electrical Industries, Chicago.

WANTED—Position with street railway as manager, superintendent or electrician. At present electrical engineer of a forty car system. Experienced in construction and maintenance of street railways and power houses. Can furnish the best of references as manager, superintendent, etc. Address K. H. S., Electrical Industries.

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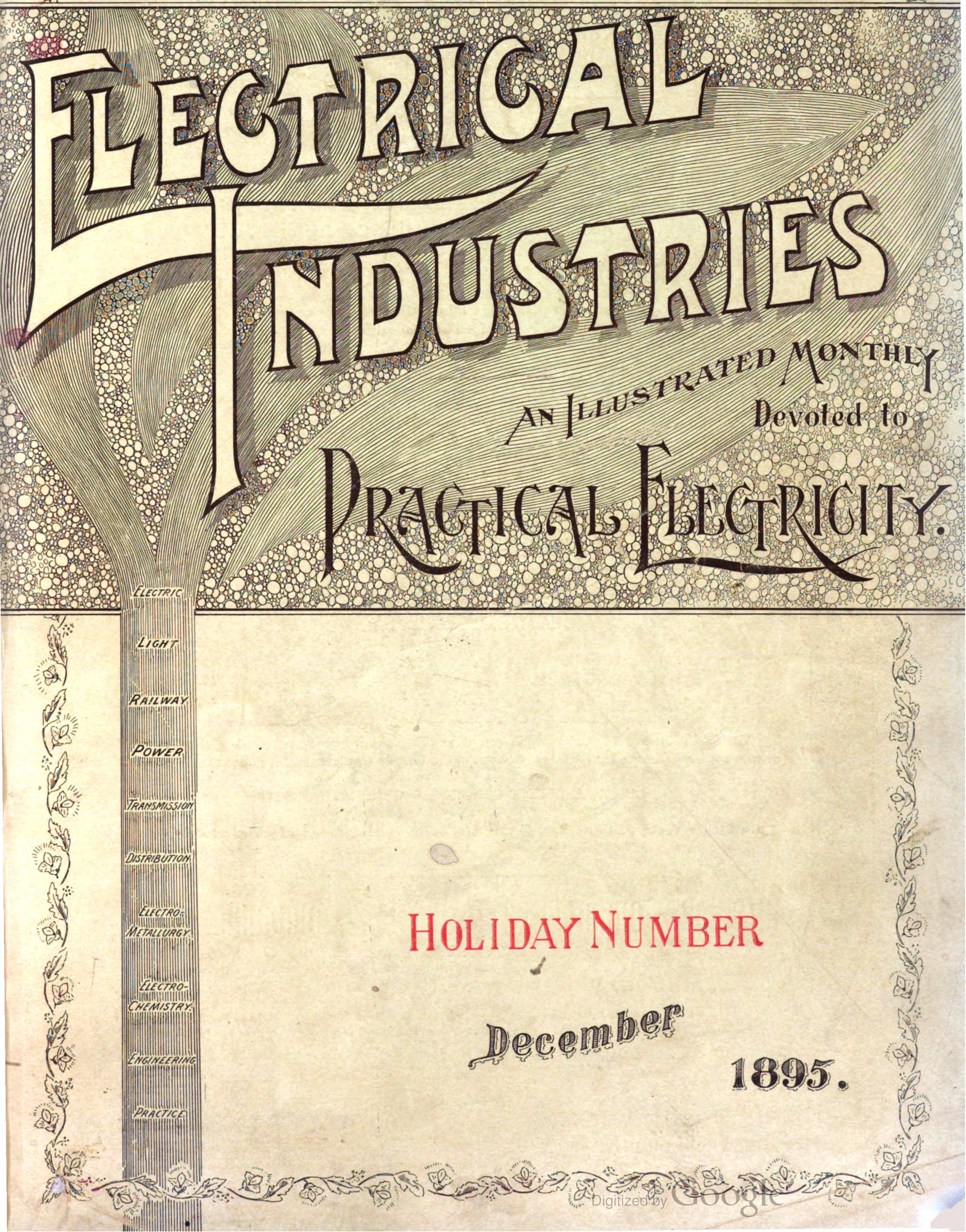

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December

1895.

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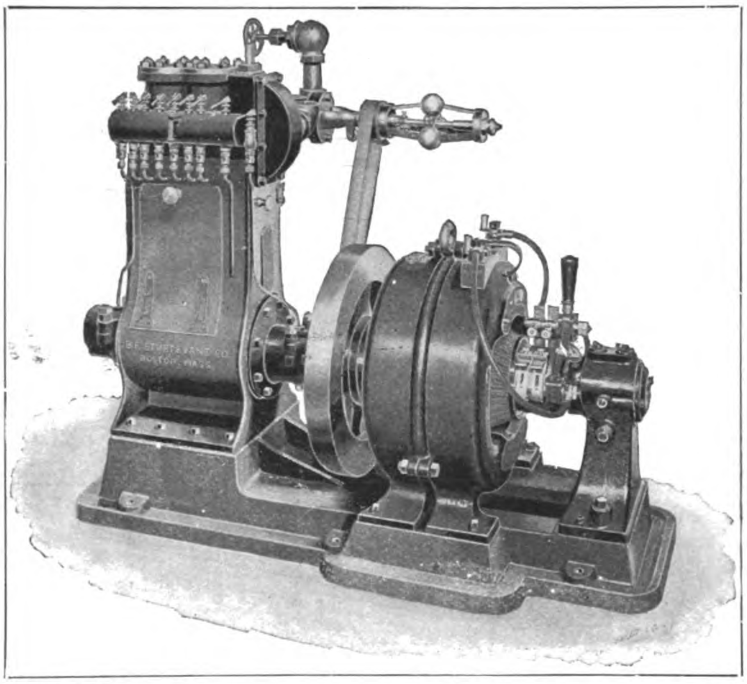

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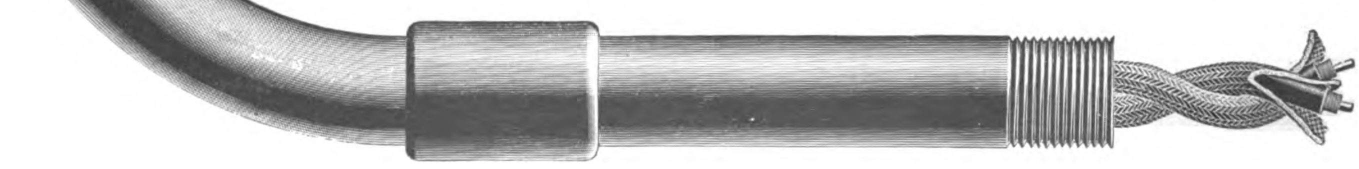

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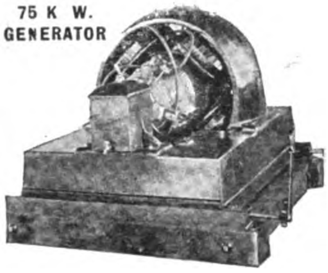

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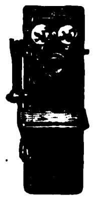

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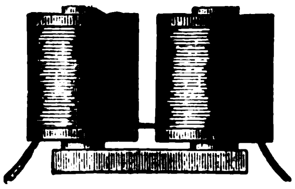

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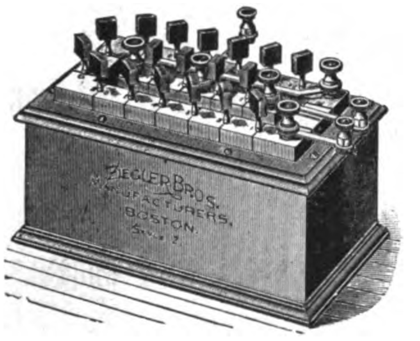

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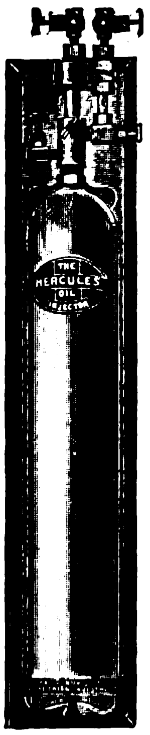

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Riker Electric Motor Co., Brooklyn, N. Y.
Shawhan-Thresher Electric Co., Dayton, O.
Siemens & Halske Electric Co. of America.
Standard Electric Co., Chicago.
Standard Electrical Works, Cincinnati.
Standard Electric Co., Pittsfield, Mass.
Western Electric Co., Chicago.
Westinghouse Electric Mfg. Co., Pittsburgh, Pa.
Ziegler Electric Co., Boston, Mass.

EBONITE.—(See Insulating Material.)

ELECTRIC HEATING APPARATUS—(See Heating Apparatus, Electric.)

ELECTRIC LIGHT FIXTURES.—(See Fixtures.)

ELECTRIC RAILWAY SUPPLIES.—(See Supplies, Electric Railway.)

ELECTRICAL ENGINEERS.—(See Engineers.)

ELECTRICAL ENGINEERS, CONTRACTING.—(See Contractors).

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WIRES AND CABLES,
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General Electric Co., Schenectady, N. Y.

ELEVATING AND CONVEYING MACHINERY.
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Bain, Foree, Chicago.
Barry & McTighe, New York.
Caldwell, Chas. C., Shelbyville, Ind.
Comstock, L. K., Co., Chicago.
Kintne , C. J., New York.
Monrath, Gustave, Chicago.
Walters, A. M., Chicago.
Westinghouse, Church, Kerr & Co., New York.
Woods, C. E., Co., Chicago.

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Schleicher Schumm & Co., Philadelphia, Pa.

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Allis, E. P., & Co., Milwaukee, Wis.
Armington & Sims Engine Co., Providence, R. I.
Atlas Engine Works, Indianapolis. Ind.
Ball Engine Co., Erie, Pa.
Buckeye Engine Co., Salem, O.
Bullock, M. C., Mfg. Co., Chicago.
Erie City Iron Works, Erie, Pa.
Ide, A. L., & Son, Springfield, Ill.
McIntosh, Seymour & Co , Auburn, N. Y.
New England Engineering Co., Chicago.
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Payne, B. W., & Sons, Elmira, N. Y.
Phœnix Iron Works Co., Meadville, Pa.
Stearns Mfg. Co., Erie, Pa.
Watertown Steam Engine Co., Watertown, N. Y.
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Bates, D. L. & Bro., Dayton, O.
Diehl & Co., New York.

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Phœnix Automatic Filter Co., Racine, Wis.

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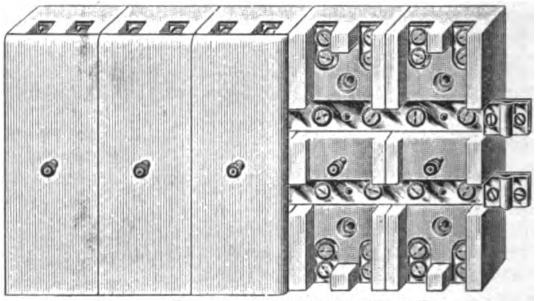

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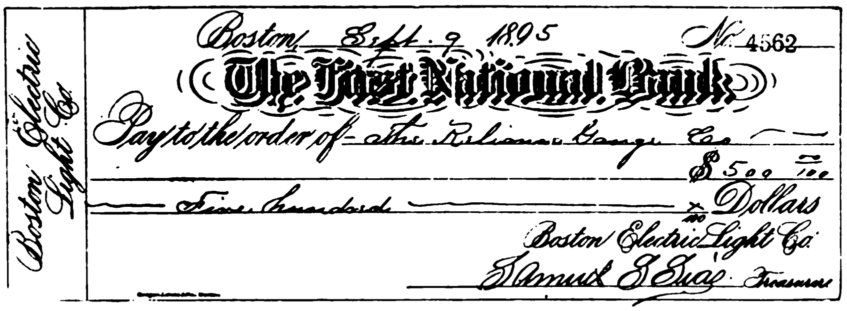

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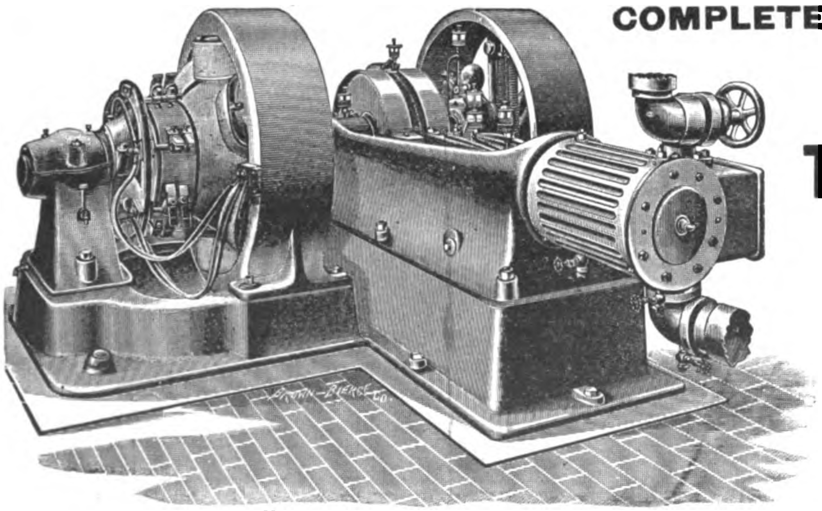

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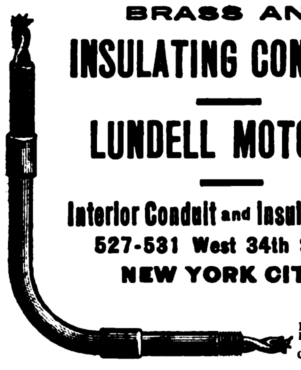

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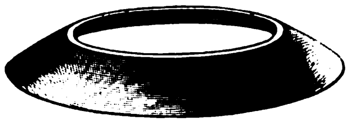

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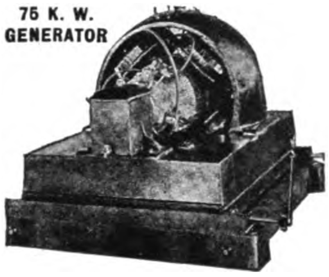
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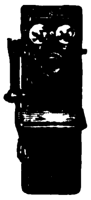

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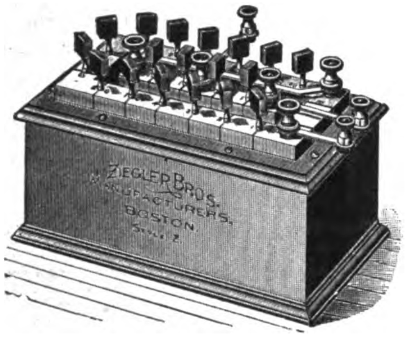

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INSULATING MATERIALS.
American Hard Fibre Co., Newark, Del.
Electrose Mfg. Co., New York.
Empire China Works, Greenpoint, N. Y.
Goodrich Hard Rubber Co., Akron, O.
Standard Paint Co., New York.

INSULATORS.
Central Electric Co., Chicago.
Cutter George, Chicago.
Electric Appliance Co., Chicago.
Empire China, Works, Greenpoint, N. Y.
Hammond Cleat & Insulator Co., Boston, Mass
Metropolitan Electric Co., Chicago.
Partrick & Carter Co., Philadelphia, Pa.
Standard Electrical Works, Cincinnati, O.
Wallace Electric Co., Chicago.
Western Electric Co., Chicago.

INSTRUMENTS, ELECTRICAL.
Central Electric Co., Chicago.
Colgate, Geo. L., & Co., New York.
Electric Appliance Co., Chicago.
Fort Wayne Electric Corporation, Fort Wayne, Ind.
Ritchie, E. S., & Sons, Brookline, Mass.
Varley Duplex Magnet Co., New York.
Wallace Electric Co., Chicago.
Western Electric Co., Chicago.
Weston Electrical Instrument Co., Newark, N. J.
Ziegler Electric Co., Boston.

LAMPS, ARC.
Brush Electric Co., Cleveland, O.
Clark Electric Co., New York.
Ft. Wayne Electric Corporation, Fort Wayne, Ind.
General Electric Co., Schenectady, N. Y.
General Incandescent Arc Light Co.. New York.
Graves, W. D., Elec. and Machine Co., Cleveland, O.
Perkins Electric Switch Mfg. Co., Hartford, Conn.
Siemens & Halske Electric Co., Chicago.
Standard Electric Co., Chicago.
Standard Electrical Works, Cincinnati.
Waterman, Chas. H., New York.
Western Electric Co., Chicago.
Westinghouse Electric and Manufacturing Co. Pittsburgh, Pa.

LAMPS, INCANDESCENT.
American Electrical Mfg. Co., St. Louis.
Beacon Vacuum Pump & Electric Co., Boston, Mass.
Central Electric Co., Chicago.
Columbia Incandescent Lamp Co., St. Louis, Mo.
Cutter, Geo., Chicago.
Davis Electrical Works, Springfield. Mass.
Electric Appliance Co., Chicago.
General Electric Co., Schenectady, N. Y.
Metropolitan Electric Co., Chicago.
New York & Ohio Co., Warren, O.
Partrick & Carter Co., Philadelphia.
Perkins Electric Switch Mfg. Co., Hartford, Conn.
Standard Electrical Works, Cincinnati.
Sunbeam Lamp Mfg. Co., Chicago
Wallace Electric Co., Chicago.
Western Electric Co., Chicago.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

LIGHTNING ARRESTERS.
General Electric Co., Schenectady N. Y.
Shane, Harry M., New York.
Wallace Electric Co., Chicago.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Ziegler Electric Co., Boston, Mass.

LOCOMOTIVES, ELECTRIC MINE.
Jeffrey Mfg. Co., Columbus, O.

LUBRICANTS.—(See Oils, Lubricants.)

LUBRICATORS.—(See Supplies Engineers.)

MACHINISTS' LATHES, TOOLS, ETC.
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Niles Tool Works, Hamilton, O.
Standard Tool Co., Cleveland, O.

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Varley Duplex Magnet Co., New York
Ziegler Electric Co., Boston, Mass.

MAST ARMS.
Brady, T H., New Britain, Conn.
Morris, Tasker & Co., Philadelphia.

METERS, ELECTRIC.
Fort Wayne Electric Co., Fort Wayne, Ind.
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

MICA.
Belden, F. E., Mica Mining Co., Boston.
Sills, W. H., Chicago.
Munsell, Eugene, & Co., New York.
Schoonmaker, A. O., 158 William st., New York.

MINING MACHINERY, ELECTRIC.
General Electric Co., Schenectady, N. Y.
Independent Electric Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.

MODEL WORK.—(See Patterns and Model Work.)

MOTORS, ELECTRIC.
Belknap Motor Co., Portland, Me.
"C. & C." Electric Motor Co., New York.
Card Electric Co., Mansfield, O.
Crocker-Wheeler Electric Co., New York.
Detroit Motor Co., Detroit, Mich.
Diehl & Co.. New York.
Dallett, Thos. H. & Co., Philadelphia.
Eddy Electric Mfg. Co., Windsor, Conn.
Emerson Elec. Mfg. Co., St. Louis.
General Electric Co., Schenectady, N. Y.
Jenney Electric Motor Co., Indianapolis, Ind.
Partrick & Carter Co., Philadelphia.
Quaker City Electric Co., Philadelphia.
Shawhan-Thresher Electric Co., Dayton, O.
Siemens & Halske Electric Co., Chicago.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.
Ziegler Electric Co., Boston, Mass.

OILS, LUBRICATING.
Lord, Geo. W., Philadelphia.
Standard Oil Co., Cleveland, O.
Vacuum Oil Co., Rochester, N. Y.

PACKING, STEAM.
Goodsell, B. W., Chicago.
Hine & Robertson, New York.

PAINTS, INSULATING.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Morris & McCurdy, Indianapolis. Ind.
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Willson, H. B., & Co., Washington, D.

PATTERN AND MODEL WORK.
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PIPE AND BOILER COVERINGS.—(See Coverings.)

PLATINUM.
Goldsmith Bros., Chicago.

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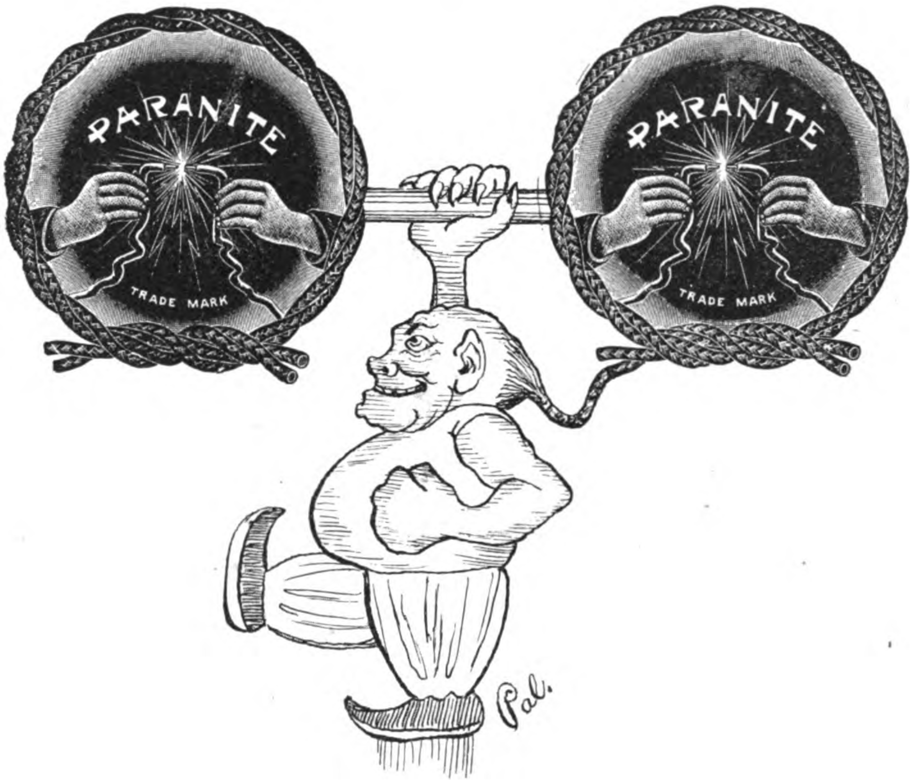

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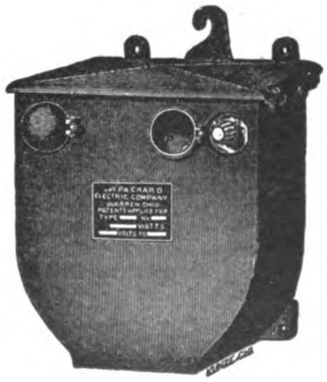

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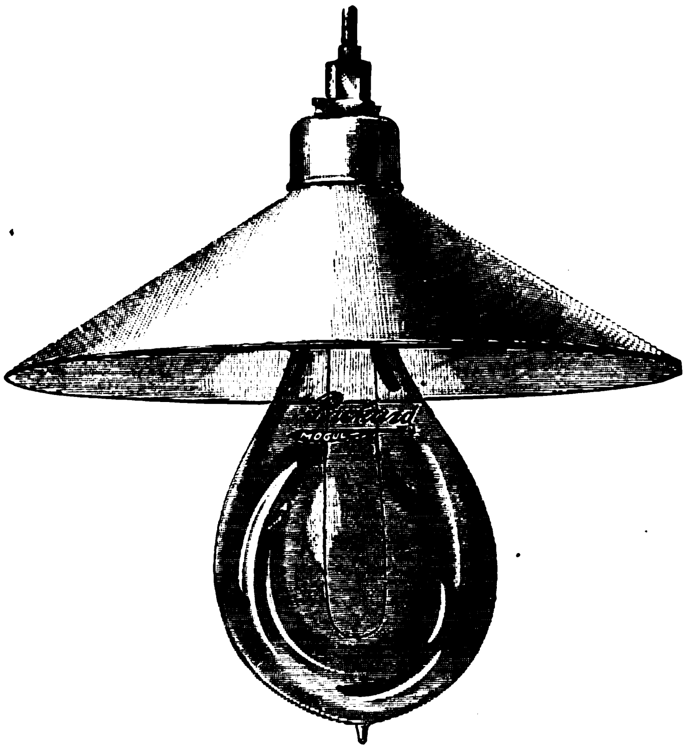

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Have you coal to burn? Is its cost an important factor? Have you considered improved methods?

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When the art has advanced by gradual improvement, its development makes less impression. Its record takes the place of representation and its merits are more reliably known.

BURNING COAL TO ADVANTAGE.

Follow the practice from the time of in efficient boilers, cramped flues, low stacks, poor grates and worse settings, to the day of good boilers well set, with high stacks, and the various fuel and labor saving attachments, from cleaning devices to damper regulators; and from shaking grates to mechanical stokers.

SOMETHING TO THINK ABOUT.

A hot fire gets the most heat out of the coal.

When you have a hot fire under a boiler and a low stack temperature your coal is making lots of heat and you are using it.

Don't be deceived into thinking your economy is good merely because the stack temperature is low.

Sometimes a high stack temperature is economical because the greater economy of a hot fire more than makes up for the loss through the stack.

WHAT TO DO.

Get the hottest fire you can out of your coal through perfect combustion.

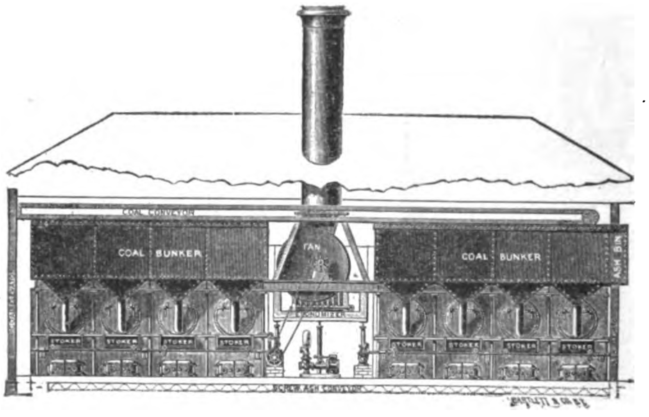
Get the lowest stack temperature possible by sending the heat into the water, not up the stack.

To do this, mechanical stoking is necessary in making a hot fire and keeping it hot all the time.

An economizer and mechanical draft plant is necessary to utilize the surplus heat which the boiler will not take up.

TO ANSWER SOME POSSIBLE QUESTIONS.

The stoker feeds coal uniformly; burns it clean, and in fact is a first class fireman who performs his duty without opening doors.



The labor saving in many cases exceeds the direct fuel saving.

The economizer puts the waste heat into the feed water, increasing its temperature 100 degrees or more, and every 10 degrees rise saves 1% of coal.

The mechanical draft supplies as ufficient draft independent of the stack, which may be merely high enough to clear the roof and enables more heat to be put into the economizer than with natural draft. The cost of the economizer and mechanical draft rarely exceeds that of a sufficient stack.

The economizer and mechanical draft go naturally together though either may be used independent of the other. The economizer when used alone requires a high stack to give ample draft; the mechanical draft when used alone has the fan fitted with water boxes suitable for the high temperarere resulting from absence of the economizer.

IN GENERAL.

These things have advanced gradually until they have found wide application in plants from moderate sizes to the largest. Having made them a specialty, we suggest the above points for your consideration and will supply more detailed information upon a knowledge of your conditions and requirements.

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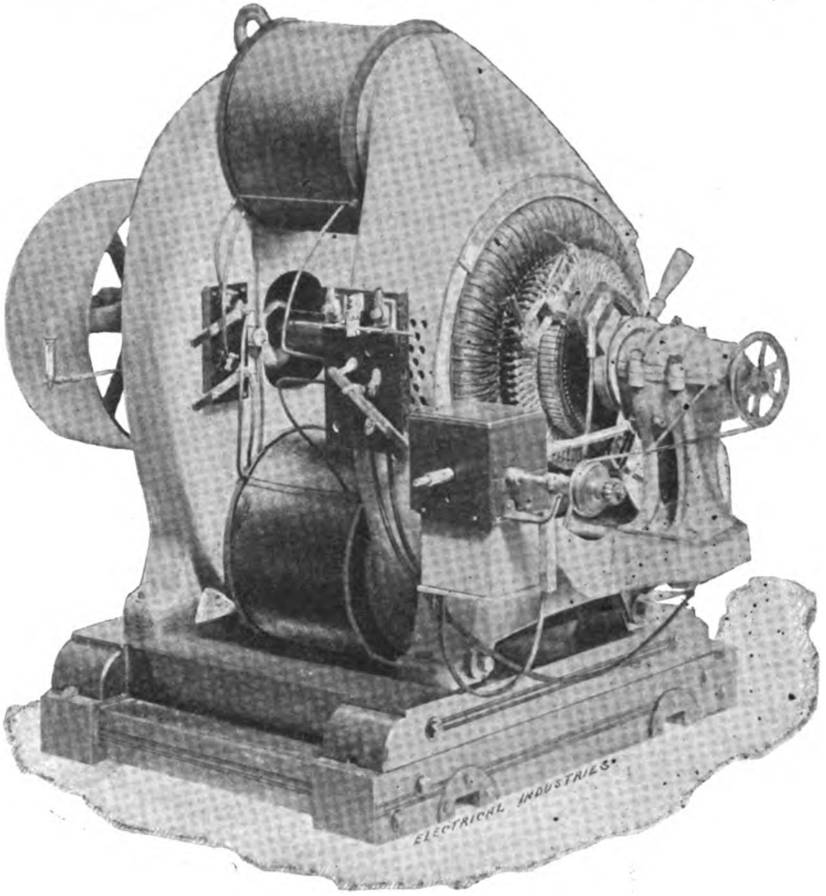
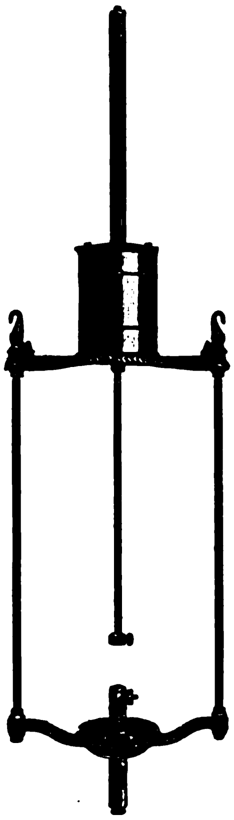
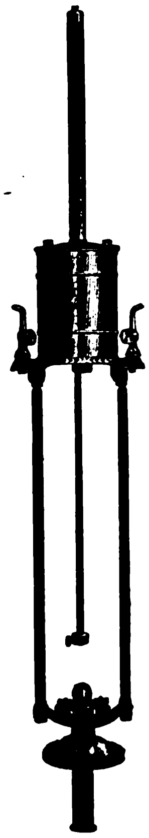


60 Light Gramme Ring Arc Dynamo.

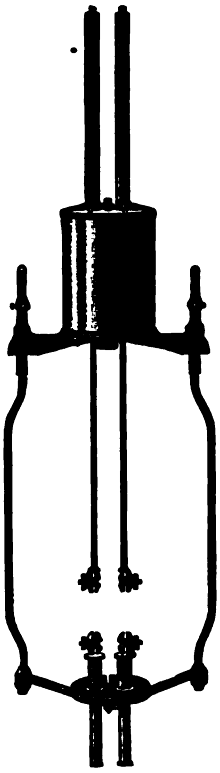


Wide Frame.



Narrow Frame.

Single Carbon All Night Service Lamps.



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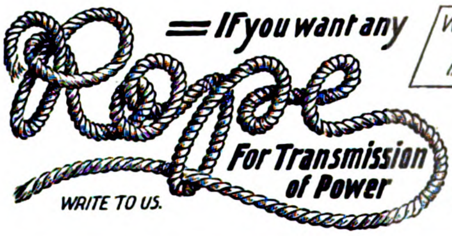

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2 M. A. Green Automatic Center Crank Engines, 14 by 14 inches, 125 Horse Power each. Built by Altoona Foundry & Machine Co., Altoona, Pa.

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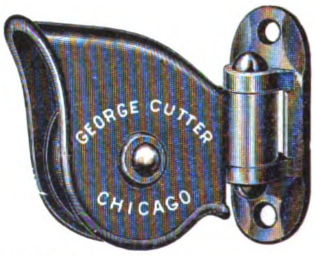

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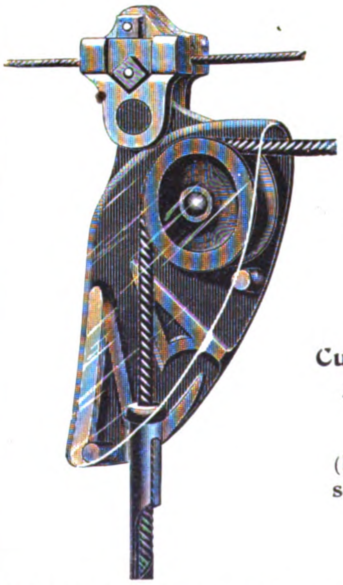
Pulley.



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N. K. Fairbank & Co., Chicago, Ill.
Jones & Laughlins Co., Ltd., Pittsburg, Pa.
Bowling Green Office Bldg., New York.
C. Pardee Works, Perth Amboy, N. J.
Chicago Edison Co., Chicago, Ill.
Cedar Rapids Elec. Lt. & Power Co., Cedar Rapids, Ia.
San Antonio Brewing Assn., San Antonio, Tex.
J. Walker Brewing Co., Cincinnati, O.
L. Hoster Brewing Co., Columbus, O.
American Brewing Assn., Houston, Tex.
Galveston Brewing Co., Galveston, Tex.
C. Moerlein Brewing Co., Cincinnati, O.
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Orleans Railroad Co., New Orleans, La.
Louisville Street Railway Co., Louisville, Ky.
Bergen Co. Traction Co., Edgewater, N. J.
Luzerne, Dallas & Harvey's Lake St. Ry. Co., Wilkes Barre, Pa.
Hartford Street Railway Co., Hartford, Conn.
Lynchburg & Rivermont St. Railroad, Lynchburg, Va.
Toledo Traction Co., Toledo, O.
J. G. Brill Co., for So. African Street Railway.
De La Mars Gold Mining Co., De La Mars, Nev.
E. J. Steiber, Unity Tunnel, Silverton, Col.
Independence Mine, Cripple Creek District, Col.
Anaconda Mining Co., Anaconda, Mont.
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Maine State College, Orono, Maine.
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Parliament Bldg., Victoria, B. C.
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Eastman's Company, New York.
Indianapolis Gas Co., Cicero, Ind.
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Arlington Mfg. Co., Arlington, N. J.
Fisher Bldg., Chicago, Ill.
Rockford Sugar Works, Rockford, Ill.
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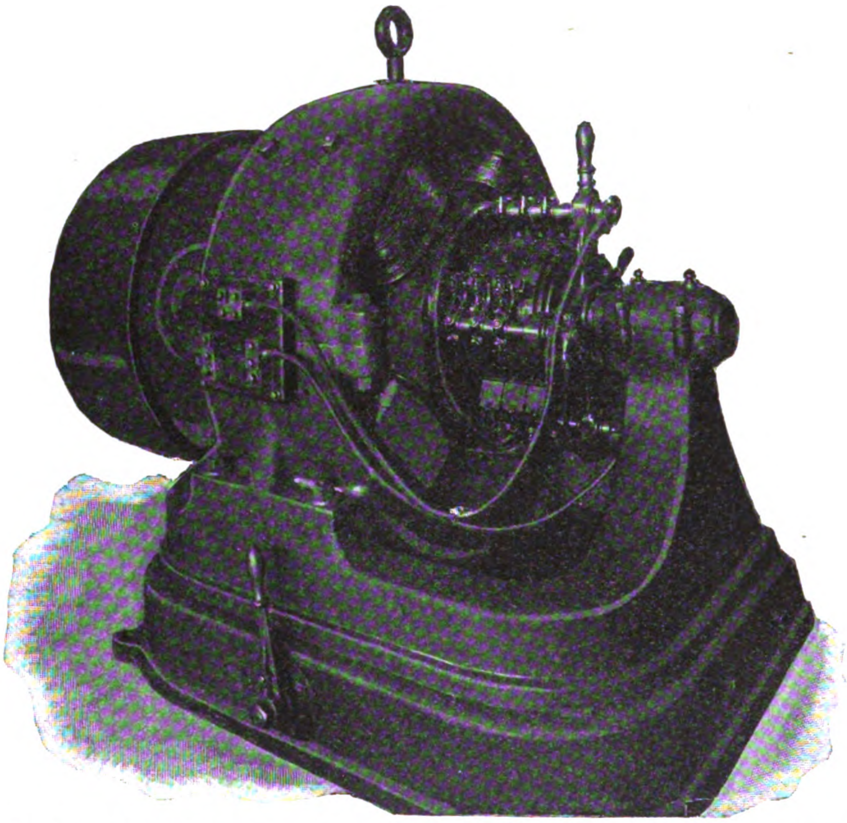

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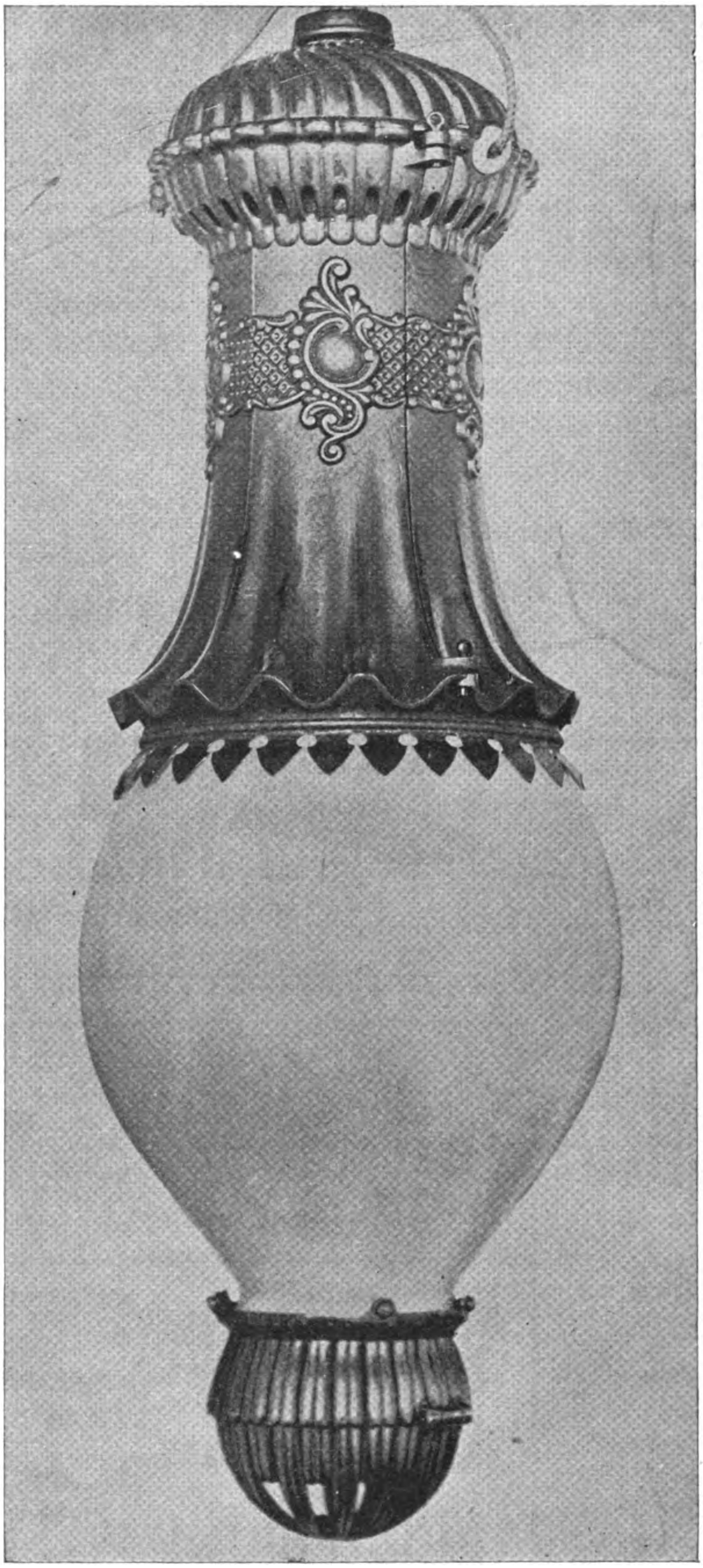

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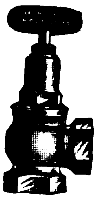

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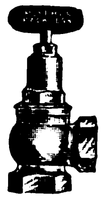

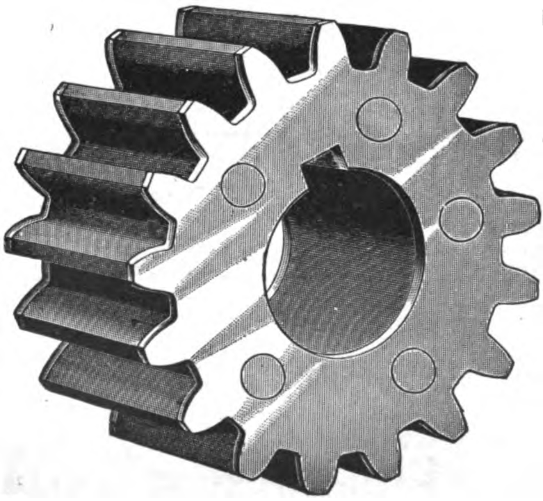

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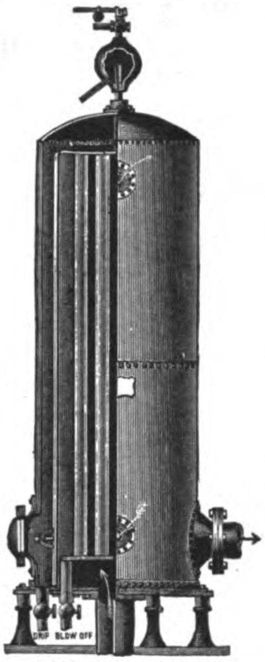

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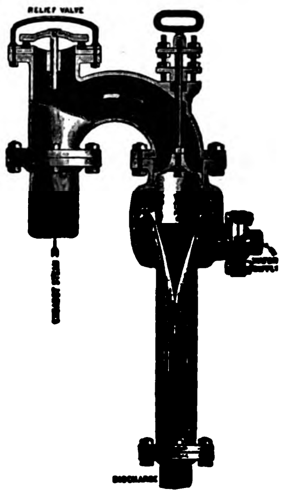

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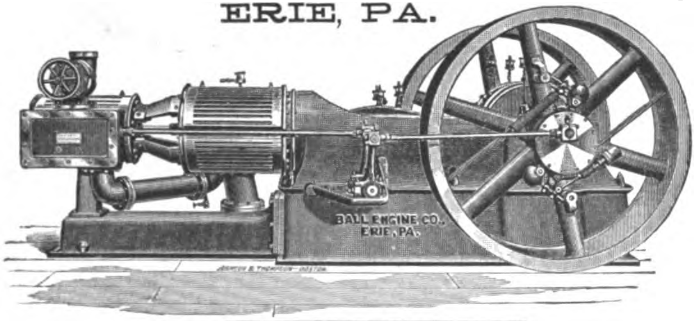
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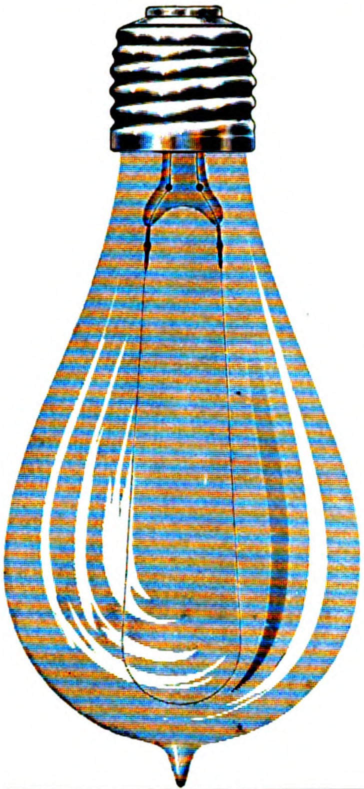

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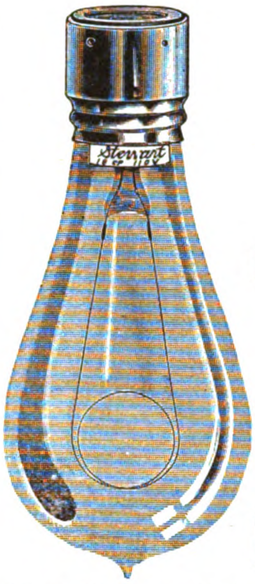

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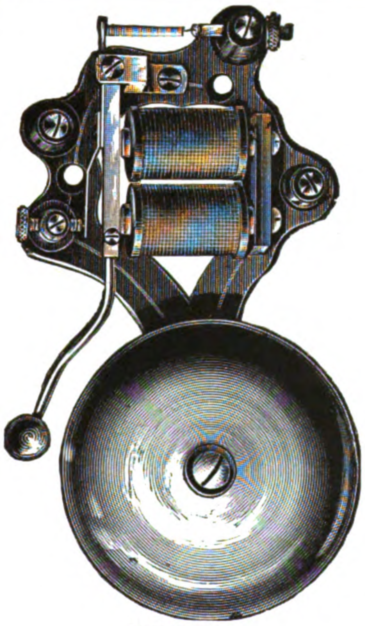

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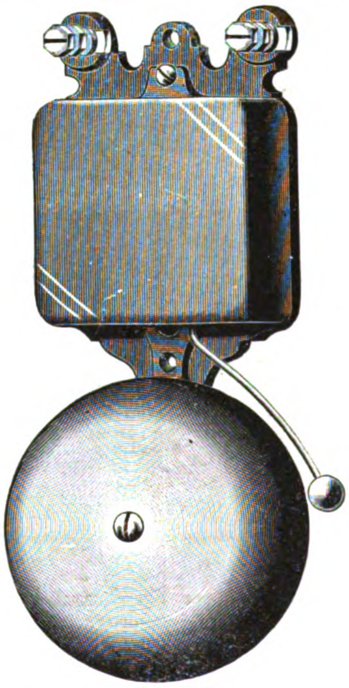

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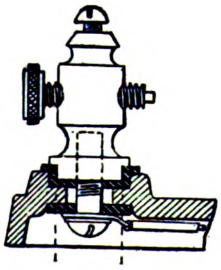

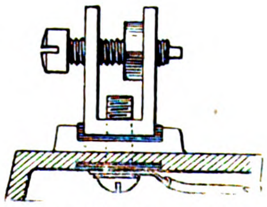

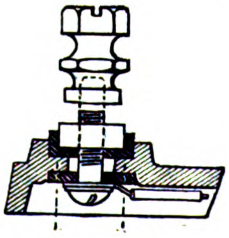

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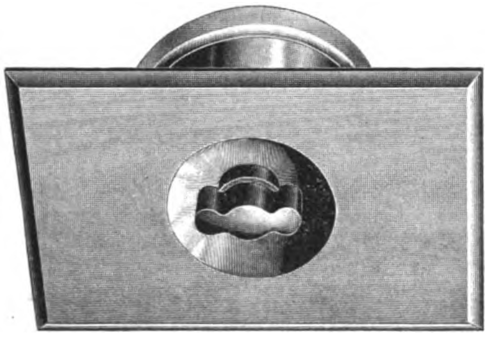

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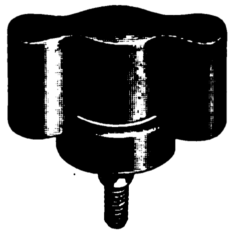

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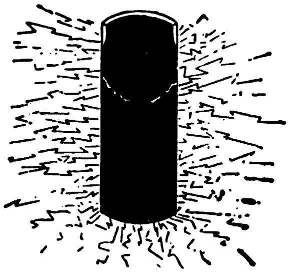

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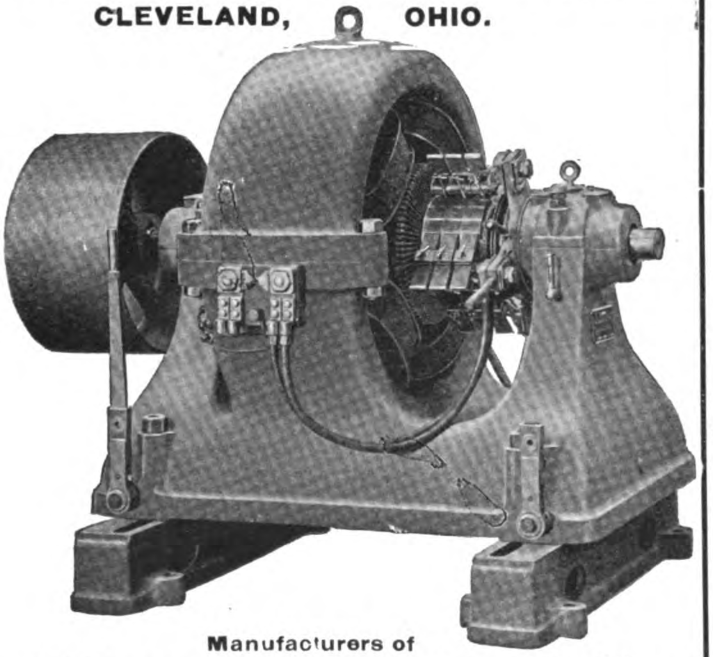

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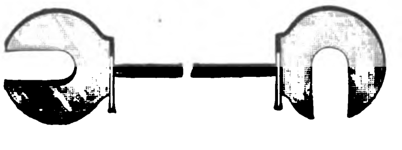

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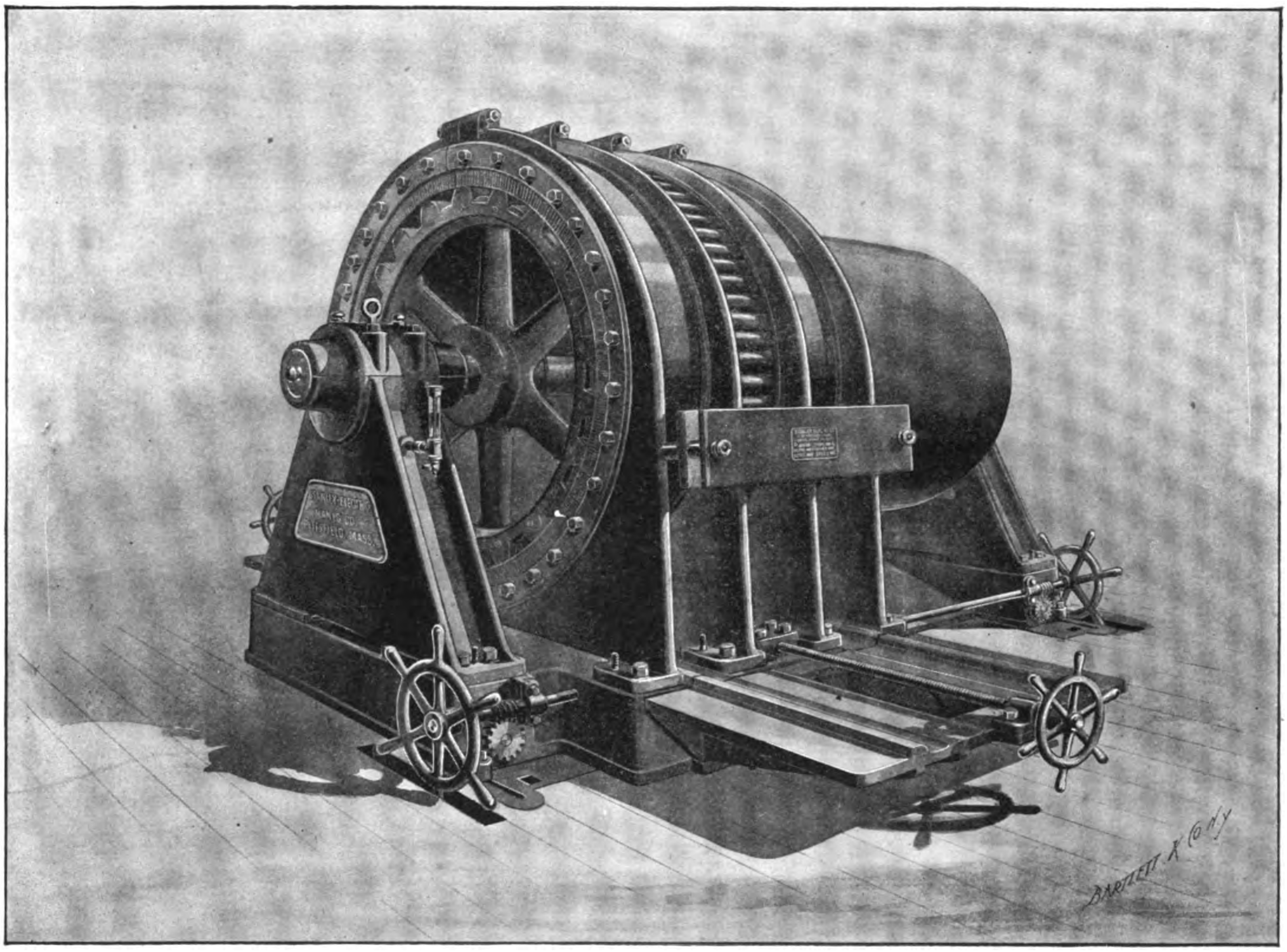

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